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China Report

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT--38

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CHINA REPORT

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT--38

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NATIONAL POLICY

PRINCIPLES OF ENERGY ACT READJUSTMENT EXPLAINED

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 6, 25 Dec 84 pp 11-12, 42

[Article by Wu Zhonghu [0702 6988 3840]: "The Principles of Energy Act Readjustment"]

[Text] The political, economic, and social pressures brought on by the energy shortage of the 1970's has greatly accelerated the legislative process of the energy act. Today the energy act has gradually developed into a complete legal framework for the survey, development, production, processing, conversion, shortage, distribution, consumption, and conservation of energy. It is the legal manifestation and guarantee of a nation's desire to develop and utilize its energy resources. After the 1973 energy crisis, the United States, Japan, the United Kingdom, France, the Soviet Union, and Romania have all moved forward in their energy legislation and formulated their [individual] energy acts, conservation acts, and energy management regulations.

Since 1979 China has been actively engaged in its economic legislation and established the various levels of energy management administrations. There has been an objective need for a strengthened energy management legislation and a series of separate rules and regulations has been issued. This is something new in China's economic legislation, but in view of the current status of China's energy development and management, this energy legislation must be further strengthened. In order to realize the grand goal of quadrupling the gross value of production by the year 2000 and to solve the energy problem, a complete series of energy legislation and energy management regulations are sorely needed.

The study of the energy act should include the content and the form of the legislation, the principles of the readjustment, the targets of the readjustment, and other theoretical questions. These are major research topics for energy economists and law scholars.

Social and economic issues are involved in each of the links of the energy consumption cycle -- from survey and development and reprocessing and conversion, to storage and transportation and distribution and supply. The economic departments are involved both in the vertical horizontal directions. The fundamental role of the energy act is that it provides the state an

enforceable legal means to readjust economic relations in the energy field, to define their legal status and their rights and obligations, so that the energy policy of the state may be implemented effectively to protect the limited energy resources, and to insure their rational development and efficient utilization for maximum economic benefit.

The readjustment principle of the energy act is one of the basic tasks of the act in readjusting social relationships. It is also the legal basis of the legislation and the fundamental basis for handling economic relationships in the energy field. By combining the energy legislative experience here and abroad with the specific situations in China, we have studied the readjustment principles of the energy act and propose the following principles for discussion.

I. The Guiding Principle for Energy Development and Utilization

In order for the state to effectively organize and promote the task of energy management, it must set energy policies based on the available resources to guide the energy legislation. Under this guiding principle, the energy legislation readjusts the legal relationships in the energy field, specifies what should be done, what is permitted and what is forbidden. Under this guiding principle the energy legislation also makes the energy act complete and self consistent.

In 1980 China proposed the following energy policy as the basis and guiding principle for its energy legislation: "Development and conservation should be put on equal footing; in the near term, conservation should be given a higher priority and the technological improvements and structural reforms of the national economy should be centered on conservation." From 1980-1982, five energy conservation directives and a series of separate regulations, including the "Specific requirements on energy conservation in industries, mines, enterprises, and municipalities," were issued in China. These regulations have been instrumental in strengthening the management, conservation and rational utilization of energy.

Faced with price hikes and supply reductions of oil, the oil consuming countries of the west have actively suppressed their oil consumption, promoted conservation and alternative energy sources. Such policies have since become law and helped to reduce oil consumption and alleviate the crisis. In Japan an additional 14 million tons of standard coal was conserved in 1979 than in 1978, and the cumulative oil conservation from 1979 to 1980 was 270 million liters.

II. Protect Energy Resources and Ensure Rational Development

The protection of energy resources and the rational development of energy are important prerequisites for the optimum utilization of energy, the maintenance of the ecological balance, and the rapid growth of the national economy. This principle implies two things. First, energy resources (mainly the earth surface resources) belong to the state and no units or individuals are allowed to exploit such resources unless they have

legally obtained the right to develop them. Second, the development plan including the method, time, and location must abide by the economic and technological policies of the state and must be approved. That is, the development of the energy resources must conform to the macroscopic economic and social efficiency of the state. For example, the site selection and design of hydropower stations must comply with the overall scheme of hydropower development of the state so that the water energy may be utilized effectively and small hydropower stations and large hydropower stations do not vie for the supply of water. Abusive mining of coal and indiscriminate logging of forest resources upset the ecological balance and are great wastes of national energy resources. Such resources should be protected by law.

III. Energy Should Be Supplied and Utilized Effectively for Maximum Economic Benefit

The supply and consumption of energy are the two important links in the management of energy resources. Unplanned supply of energy leads to losses in production and irrational use of energy leads to low economic benefits. The energy utilization rate in China is only 26 percent, far lower than that of industrially developed nations. An important fundamental principle of the energy act is to readjust the supply and demand by legal means so that the supply sector can provide sufficient high-quality energy and the consumer can use the energy with advanced technology and facility for the optimum efficiency and economic benefits.

IV. Conservation and Alternative Energy Resources

Conservation and the development alternative energy are important approaches in alleviating the energy shortage and the difficulties in the supply and demand cycle. Conservation includes the readjustment of production and product structure, the development of energy efficient products and technologies, and the adoption of advanced technology and scientific management. Any method that has demonstrated substantial economic benefits should be promoted and implemented by the energy act. China has developed a number of energy efficient devices such as high-efficiency blowers, high-efficiency water pumps and the Y-series motor. Some advanced methods and techniques have improved the production efficiency of certain enterprises, but the promotion has been difficult. Some new enterprises did not employ energy-saving techniques and equipment but turned to the state to request funds for conservation improvements after they started production. Some manufacturing plants producing energy inefficient equipment did not think of the consumer and continued to produce energy wasteful equipments. Such problems must be readjusted under the energy act.

The development of alternative energy resources is important for resolving the energy shortage problem.

V. The Planning of Energy Development and Utilization

Energy planning includes planning for the development and production of

energy, planning for the supply and demand, planning for regional energy development, planning for energy consumption by the departments and enterprises, planning for conservation, new energy resources, alternative energy resources, and research and development. In a country with a planned economy, economic development is based on planned energy development and utilization. Departments in charge of the development, production, transportation, storage, distribution, supply, and utilization of energy must all comply with the planning regulations. The implementation of the planned energy should be promoted with legislation and the economic departments must follow the law in their development and exploitation of energy.

VI. Establish Rational Energy Prices and Taxes

Rational energy price and energy tax are very important in their leverage over the utilization of energy and the generation of revenues. Many problems exist in China's energy price structure, as manifested in the irrational relative costs of energy and the lack of unified price management. A rational price system must be established to strengthen price management and change the irrational production and consumption structure as soon as possible. In the last few years China has begun collecting an energy tax and imposing price increases on fuel consumption exceeding the quota, but much more needs to be done in the efficient use of tax revenues and in readjusting the energy consumption through price. In foreign countries the manufacturing plants are taxed for the energy-wasteful products they produce. This method gets to the root of the problem and could serve as a useful reference for us.

VII. Establish An Energy Management Structure and Formulate Energy Consumption Quotas

An energy management structure organizes and implements the management of energy resources. To carry out the energy policies and regulations of the state, the law should specify the establishment condition of an energy management structure, personnel allocation, functions of the organization, the scope and target of work, and the rights and obligations of energy management. Setting energy consumption quotas is an important task in energy management and an important content of the energy act. The energy consumption of major industries and facilities should be determined by law, which serves as the basis for evaluation, rewards, and penalties of units and individuals.

VIII. Rewards and Penalties in Energy Utilization and Conservation

The three ingredients of a legal standard -- presumption, disposition, and sanction -- also apply to the case of the energy act. The sanction refers to the consequences of breaking the law, and in the case of the energy act, it refers to the economic sanction leveled against the violators of the energy act. But the energy act of China has something that is different from other laws. Besides sanctioning the violators, the energy act also rewards the units or individuals making contributions to the conservation effort. This will not only encourage conservation but also accumulate funds for the conservation effort.

NATIONAL POLICY

ESTABLISHING RADIATION PROTECTION REGULATIONS FOR NUCLEAR POWER PLANTS

Taiyuan FUSHE FANGHU [RADIATION PROTECTION] in Chinese Vol 4, No 6, Nov 84 pp 437-444

[Article by Pan Ziqiang [3382 5261 1730], Chen Zhuzhou [7115 4554 5297], Jiang Xiwen [1203 1585 2429], Xing Fuli [6717 7450 0684]: "Principles, Main Numerical Limits for Establishing Radiation Protection Regulations for Nuclear Power Plants"]

[Excerpts] I. The Principles and Basis for Establishing Regulations

The basic principles for establishing radiation protection regulations for nuclear power plants are the following: under the guideline of not exceeding the dose limit, the dosage received by the operating personnel and local residents should be limited to the lowest possible level which is scientifically supportable, economically reasonable and technologically feasible.

In establishing such regulations we must take into consideration China's current environment: (1) China is a socialist country; promoting economic development and protecting the public's health are of equal priority. (2) China is a developing country; its per capita gross national product is only one-ninth of the world's average value, hence the available funds for nuclear power development are very limited.

In view of the fact that China has not yet completed a nuclear power station on the mainland, and has little actual operating experience, our policy in establishing radiation protection regulations should be guided by very strict requirements on the one hand, and by sufficient leeway on the other. There are two different types of guidelines in the regulations: the first type is numerical limits; the second is target value, which serves as a basis for design and for establishing operating plans and control limits.

II. Baseline for Safety Standards and Danger Levels

With any human effort in scientific or productive activity, there are usually certain negative effects associated with the benefits it generates; these negative effects are called detriments. Therefore, in deciding whether to undertake a particular activity, one should not be concerned with the potential detriment, but rather should ask himself the following questions: Do the bene-

fits of the activity outweigh the detriment? How does this type of detriment compare with the detriments of other activities? Is this type of detriment acceptable by the general public?

Nuclear energy is one of today's most promising new energy sources. Developing nuclear energy is essential for the development of China's national economy. An important question that must be addressed in developing nuclear energy is: what type of safety standard baselines should be adopted? We believe that in establishing such baselines for nuclear power plants, the following guidelines should be followed: (1) they are safe relative to other types of industries; (2) they are economically feasible. In addition, we should also consider whether they are acceptable by the public.

Detriment is a measure of the possibility and magnitude of the negative effects. To compare the detriments of different industries, it is necessary to establish a quantitative measure of the level of detriment. Clearly, this is a very difficult problem. Detriment has very wide implications; it includes the effects on the environment and effects on the human psychological well being as well as direct effects on human health. The effects on human health can be further divided into two categories: deaths and injuries caused by accidents, and job-related deaths and injuries. At present, it is not possible to assign a quantitative measure of detriment in this broadest sense. Efforts are under way to study various quantitative indices for measuring the effects on human health; the most commonly used index is the equally weighted sum of lost man-years resulting from all types of detriments. However, due to incomplete statistical data on job-related injuries and diseases, uncertainties in certain effects, and the question of whether it is reasonable to add different types of detriments with equal weighting, the job-related death rate is still used as the main criterion for comparing the safety of different industries. In this article, we also use this criterion in selecting the safety standard baselines.

But what would be a reasonable danger level for the general public? (1) Clearly, it should be lower than the danger level for job-related accidents; hence it should not exceed 10^{-5} ; (2) It should be comparable to the death rate caused by natural phenomena such as lightning, which is approximately 3×10^{-6} [4]. Based on the above argument, the danger level for the general public should be chosen to be in the range 10^{-5} - 10^{-6} .

Table [1] lists the specifications of danger levels used by some countries and organizations in establishing safety standards or radiation protection standards for nuclear power plants. The table shows that for personnel of the nuclear profession, it is 10^{-4} ; for the general public, it is 10^{-5} - 10^{-6} , and for all nuclear power stations it is 10^{-6} . Since the Three Mile Island incident, the U.S. Nuclear Regulatory Commission announced the standard for detriment for the general public caused by reactor accidents to be $1/10^3$ of the sum of danger levels of all types of accidents or $1/10^3$ of the morality rate due to cancer. This standard actually corresponds to a danger level of 10^{-6} , but it was started in a common language so it could be easily understood by the general public.

To summarize, we believe that in establishing the radiation protection standards for China's nuclear power plants, the radiation danger level should be 10^{-4} for professional personnel and 10^{-5} for the general public.

Table [1] Danger level specifications used in some countries and organizations in establishing safety standards or radiation protection standards.

Issuing organization	Acceptable danger level		Remarks
	Professional personnel	General public	
Int'l Radiation Protection Commission	10^{-4}	$10^{-5} - 10^{-6}$	
British Central Power Bureau	10^{-4}	10^{-6}	
U.S. study reports on reactor safety (1975)		10^{-5} (tolerable) 10^{-6} (unconcerned)	
U.S. Nuclear Regulatory Commission Report (1982)		$1/10^3$ of sum of danger levels of accidents (corresponding to danger level of 5×10^{-7}) or $1/10^3$ of death rate caused by cancer (corresponding to danger level of 1.9×10^{-6})	Refers to reactor accidents; does not include effects of normal discharge. Danger level refers to area adjacent to nuclear power plant.

III. Evaluation Model of Radiation Detriment

There are two kinds of radiation detriment evaluation model: absolute detriment model and relative detriment model. The absolute detriment evaluation model assumes that during the entire danger period, the detriment produced by unit dosage remains constant. The relative detriment evaluation model assumes that the detriment produced by unit dosage depends on age; the relative detriment coefficient is proportional to the coefficient of age dependency of normal rate of cancer occurrence. The relative detriment model will predict a larger number of cancer occurrences, but the age of disease occurrence will also be higher. Therefore, the overall detriment values estimated by the two models are essentially the same. For simplicity, we use the absolute detriment evaluation model.

According to the recommendation of the ICRP-26 report, the danger coefficient of radiation-induced fatal cancer is $1.25 \times 10^{-4} / \text{man} \cdot \text{rem}$. In our evaluation of radiation detriment, we shall choose the danger coefficient to be $2 \times 10^{-4} / \text{man} \cdot \text{rem}$.

IV. Job Related Radiation Limit

For job-related radiation limit, we use the international standard, which requires that the effective yearly dosage equivalent received by members of the work crew be limited to 5 rem. In calculating effective dosage equivalent, we used the factors for the danger levels of various tissues and organs as recommended by the ICRP-26 report. Table [2] lists the values given in the ICRP-26 report and recent recommendations by the U.S. Environmental Protection Agency (EPA). The EPA did not specify a factor for the sex glands primarily to avoid the intermixing of hereditary effects and body effects. In view of the wide acceptance of the ICRP-26 report, we have used its recommended values in establishing the regulations.

Table [2] Factors for the relative danger levels of tissues and organs

Tissue of organ	ICRP-26 Report	U.S. EPA
Sex glands	0.25	
Mammary glands	0.15	0.20
Red bone marrow	0.12	0.16
Lungs	0.12	0.16
Thyroid	0.03	0.04
Bone surface	0.03	0.03
Skin	0.01	0.01
Other tissues	0.30	0.08
		(Each of the five organs receiving the highest dosage)
Total	1.01	1

The equivalent dosage limit for eye tissue is 5 rem per year. This limit is chosen as the lowest value that can be achieved without much difficulty.

In order to control the aggregate equivalent dosage, we proposed the following regulation: "under normal operating conditions, the average effective dosage received by members of the work crew of a nuclear power station per year should

be less than 0.5 rem. If the overall plan calls for a special operation which will cause the average effective dosage to exceed this value, then a cost-benefit trade-off study should be conducted to decide if such radiation level is acceptable." The basis for posing this regulation is as follows:

(1) It is acceptable from the danger level viewpoint because 0.5 rem corresponds to a danger level of 10^{-4} , which is the baseline for industrial safety.

(2) It is technologically feasible and economically reasonable. Table [3] shows the yearly average equivalent dosage of job-related radiation levels of nuclear power plants in eight countries, and the percentage of those stations whose average dosage levels are greater than 5 rem. It can be seen that the average equivalent dosage is generally less than 0.5 rem; the overall average is 0.41 rem, the lowest is 0.14 rem and the highest is 0.58 rem. Table [4] lists the job-related radiation received by members of the work crew of China's two experimental reactors. It shows that the yearly average equivalent dosage is close to or less than 0.5 rem. The reason that some reactor workers in this country receive more than 0.5 rem per year is primarily due to mismanagement and inadequate protection measures. From 1969 to 1979, the dosage produced by accidents were 23 percent of the total dosage; during 1 year, it was as high as 60 percent. Based on existing data and analyses, and the experience gained in recent years, it is possible to further reduce the dosage received by the work crew without significantly increasing the amount of investment. Since the Radiation Protection Association held a conference on "Statistics and Assessment of Job-Related Radiation Levels Received by Members of the Work Crew" in early 1981, the problem of excessive exposure to radiation by members of the work crew has received much attention; many organizations have taken effective measures and evidence of reduction in the dosage received by reactor crew members have been observed. Table [5] lists the job-related radiation level received by the work crew of a heavy-water reactor used for research. After its reconstruction in 1979, the power output of the reactor has increased from 10 MW to 15 MW; but as a result of more effective management policies and protection methods, the yearly average equivalent dosage received by the work crew in 1981 and 1982 decreased to 0.12 rem and 0.10 rem, which were approximately 1/5 to 1/6 of the level before the reconstruction. At present, China has no nuclear power plant on the mainland, therefore, we have no actual data; but based on the operation of nuclear power plants in other countries and based on the actual experience with China's reactors, we believe it is entirely possible to control the yearly average equivalent dosage of job-related radiation received by the work crew to below 0.5 rem.

V. Environmental Radiation

A comprehensive standard of environmental radiation should include: (1) equivalent dosage limit on individuals; (2) aggregate equivalent dosage limit, i.e., the aggregate equivalent dosage from radioactive fluid discharge or solid waste produced by each reactor (or based on location or unit generator capacity); (3) yearly gaseous and liquid discharge limit; (4) limit on the concentration of radioactive substances in the environmental medium. Under normal operating conditions, the aggregate equivalent dosage limit depends on many factors; hence it is difficult to assign a quantitative measure to it. The limit on the con-

Table [3] Yearly Average Equivalent Dosage of Job-Related Radiation Levels of Nuclear Power Plants in Eight Countries and the Percentage of Stations With Average Dosage Greater Than 5 rem [10]

Country	Year	Subjects Observed	Percentage of points > 5 rem		Yearly average equivalent dosage, rem	
			Range	Mean value	Range	Mean value
U.S.	1973-1978	321510	0.14-0.75	0.41	0.35-0.48	0.43
U.K.	1972-1977	31658	0	0	0.23-0.41	0.28
France	1970, 1971, 1974	4720	0.12-0.88	0.4	0.34-0.55	0.43
Sweden	1977, 1978	6987	0	0	0.24-0.29	0.27
Argentina	1974, 1975	588	0	0	0.31-0.44	0.38
Italy	1963-1970	4443	0-0.17	0.02	0.14-0.58	0.39
Switzerland	1975	369		0		0.52
Japan	1977	25362		0		0.32
Total		395637		0.34		0.41

Table [4] Job-related Radiation Level Received by Work Crew of China's Two Experimental Reactors

Reactor Type	Period	Yearly aggregate equivalent dosage, man-rem		Yearly average equivalent dosage, rem		Pct of yearly equivalent dosage greater than 5 rem	
		Range	Mean Value	Range	Mean Value	Range	Mean Value
Heavy water research reactor	1959-1982	17.91-162.6	72.17	0.10-1.39	0.58	0-2.8	0-2.8
Swimming pool type reactor	1976-1982	1.8 - 20.2	7.26	0.02-0.23	0.087	0	0

Table [5] Job-Related Radiation Level Received by Work Crews of Heavy-Water Research Reactor

Year	Number of Personnel	Yearly aggregate equivalent dosage, man-rem	Yearly equivalent average dosage, rem	Year	Number of Personnel	Yearly aggregate equivalent dosage, man-rem	Yearly equivalent average dosage, rem	Percentage of yearly equivalent dosage greater than 5 rem
1959	110	1.39	0.9	1971	95	48.2	0.51	1
1960	121	1.34		1972	98	87.6	0.89	1
1961	108	0.95		1973	115	65.8	0.57	
1962	135	0.53		1974	118	43.2	0.37	
1963	127	0.28		1975	121	65.2	0.54	
1964	135	0.46		1976	143	34.4	0.24	
1965	191	0.41		1977	130	115.0	0.88	
1966	160	0.42		1978	125	77.1	0.62	
1967	134	0.70	0.62	1979	199	108.8	0.55	
1968	136	0.33	1.5	1980	168	49.4	0.29	
1969	108	0.61	2.7	1981	158	19.5	0.12	
1970	84	0.73		1982	179	17.91	0.10	

centration of radioactive substances in the environmental medium has been given in other standards. Here, we shall mainly discuss items (1) and (3).

1. Equivalent dosage limit on individuals

We are proposing the following dosage limits: "The yearly effective dosage received by individuals in the general population due to substances from radioactive discharge cannot exceed 25 mrem; the equivalent dosage for thyroid glands cannot exceed 75 mrem per year." The basis for proposing this regulation is as follows:

(1) In terms of danger level, it is less than 5×10^{-6} for individuals, and less than 10^{-6} for the general public, both of which are lower than the acceptable standard.

(2) It is technologically feasible and economically reasonable. In this country, based on the report on assessment of environmental effects at the Qinshan nuclear power plant and feasibility study reports on other nuclear power stations, it is estimated that the maximum equivalent dosage levels for individuals due to radioactive discharge are all below 25 mrem/y. Therefore, the above standard is achievable by most commercial reactors in other countries; also, preliminary analyses of several planned reactors in this country show that this standard is technologically feasible and economically reasonable.

2. Target Value for Yearly Discharge of Gases or Gas-Carried and Liquid Substances

At each location with pressurized-water reactors, the gas-carried substances shall be: 5×10^4 Ci/y of inert gases, 2 Ci/y of iodine-131, and 5 Ci/y of particles; the liquid substances shall be: 6×10^3 Ci/y of tritium, and 20 Ci/y of total β . Under typical meteorological and hydrological conditions, the yearly discharge substances corresponding to the above target value will produce in the surrounding environment a maximum individual equivalent dosage which is much lower than 24 mrem/y. Compared with the aggregate effective equivalent dosage, the amount of total discharge is easier to measure and to control. Therefore, in most countries, the total amount of yearly discharge is clearly specified when issuing construction permits for nuclear power plants.

Among liquid substances, only 2 percent contain a tritium discharge higher than 6×10^3 Ci/y, and approximately 8 percent contain total β radiation greater than 20 Ci/y. Therefore, the above target value is easily achievable.

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CSO: 4008/162

NATIONAL POLICY

COAL INDUSTRY MINISTRY DECENTRALIZES CONTROL

OWO61121 Beijing XINHUA in English 1100 GMT 6 Mar 85

[Text] Beijing, 6 March (XINHUA)--The Ministry of Coal Industry had decentralized its control of coal cutting, today's PEOPLE'S DAILY reports.

Areas with 35 billion tons of known coal reserves have been turned over to locally run mines in the major coal-producing areas of Shanxi, Anhui, Henan, Hebei, Heilongjiang, and Shandong provinces, and the Inner Mongolia Autonomous Region in the past 3 years.

Mineral resources, water, forests, mountains, grassland, unreclaimed land, beaches, and other natural resources are owned by the state, according to China's Constitution.

Coal accounts for about 70 percent of the country's energy resources, and the coal industry remains a weak link in the national economy.

To boost coal production, the ministry has organized geological teams to help local mines find more coal reserves, and local mines are now allowed to mine verified coal deposits in areas where there is no ministry-run coal mine.

The ministry has also provided locally run mines with grant-in-aid and equipment, and has invited geological departments to help the regions.

More than 4.5 billion tons of verified coal deposits were added for locally run mines last year.

CSO: 4010/112

NATIONAL POLICY

U.S. BECHTEL GROUP BEGINS NEGOTIATIONS IN URUMQI

OW062153 Beijing XINHUA in English 1648 GMT 6 Mar 85

[Text] Urumqi, 6 Mar (XINHUA)--The Xinjiang Uygur Autonomous Region began negotiations on petroleum exploration, power stations, mining and other projects with a delegation from Bechtel China, Inc. of the United States here today.

The delegation arrived in the regional capital of Urumqi yesterday.

The northwest China autonomous region covers 160,000 square kilometers, one-sixth of China's total land mass. It has large reserves of coal, petroleum, nonferrous metals, and jade.

The U.S. firm established ties with Xinjiang last November when a delegation headed by Wang Enmao, first secretary of the regional Communist Party Committee, visited the United States.

Meeting the U.S. delegation today, Wang said that cooperation between Xinjiang and the U.S. corporation had a bright future and would benefit both sides.

Bechtel undertakes feasibility studies, consultancy services, design and construction for technical and engineering projects.

The delegation will stay in Xinjiang for a week.

CSO: 4010/105

NATIONAL POLICY

FORUM ON EASING POWER SHORTAGE IN COASTAL CITIES HELD

OW100410 Fuzhou Fujian Provincial Service in Mandarin 1130 GMT 7 Mar 85

[Text] A forum on the supply, demand, and transport of coal to Chinese cities open to the outside world was held in Fuzhou on 7 March. The forum was sponsored by the Ministry of Coal Industry. The purpose of the forum was to study the supply and demand of coal in the special economic zones and cities open to the outside world, to provide services to the special economic zones and cities open to the outside world concerning the import, export, and transport of coal and coal mining machinery and equipment; and to study how to further promote cooperation for the economic development of the special economic zones and coastal cities open to the outside world.

Gao Yangwen, Minister of Coal Industry, presided over the meeting and addressed it.

Attending the meeting on invitation were over 160 representatives from 22 special economic zones, coastal cities open to the outside world, and delta areas designated for development, as well as representatives of leaders concerned from the State Economic Commission, the Ministry of Communications, and the State Bureau of Materials and Equipment.

Hu Ping, governor of Fujian Province, spoke at the meeting.

CSO: 4013/102

POWER NETWORK

NINGXIA POWER OUTPUT HITS ALL-TIME HIGH

Yinchuan NINGXIA RIBAO in Chinese 20 Jan 85 p 1

[Article: "Ningxia Electric Power Bureau Uses Party Consolidation To Stimulate the Economy, Highest Historical Levels Reached in Three Economic Indicators Last Year"]

[Text] The Ningxia Electric Power Bureau has conscientiously used party consolidation to stimulate the economy and has used the economy to examine party consolidation. In 1984, they created the highest historical records in three economic indicators: electricity generation surpassed 2.3 billion kWh with no increase in generation capacity, a growth of 6.8 percent over plans; profits were 28 percent higher than planned despite rising fuel prices and shipping costs and a decline in coal quality; they completed 75.8 million yuan in capital construction investments, 11 percent more than planned.

The Bureau has closely integrated party consolidation with production and construction. They have searched for differences in professional guiding ideology based on the overall tasks and goals of the party and the need to "first have Ningxia stand up." CPC Committee Members and leading members of the bureau divided up and led teams on visits to all the prefectures, cities and frontier counties in Ningxia. They went to 35 major [electricity] users to solicit opinions. The Bureau CPC Committee used this as a basis for collective comparative examinations. They dealt with 93 opinions proposed by the masses and corrected professional guiding ideologies in five areas. They implemented corrections in professional guiding ideologies through reforms and made great efforts to extend systems of economic responsibility. They formulated breakthroughs to solve two cases of "eating out of the big common pot" and implemented a reform program that centered on responsibility systems, reforms in distribution systems and administrative simplification and downward transfer of authority. They began by signing economic responsibility contracts with each power plant, electricity supply bureau and other enterprises; they formulated and perfected direct expense contractual responsibility systems with construction and installation enterprises; they followed enterprise management with design and materials departments; they set up plant manager responsibility systems with repair and manufacturing enterprises; and they transferred authority

related to machinery, equipment and worker allocations, appointment and removal of cadres, and aspects related to planning and finance down to grassroots enterprises. These measures inspired the initiative and creativity of the enterprises and employees and gave the enterprises increased vigor. While implementing contractual responsibility, the Yinnan Power Supply Bureau divided up the various economic and technical indices involved in the contractual responsibility into levels and assigned responsibility by levels. Accounting was done by the power supply office (work region) and everyone had indices and checks. Rights and responsibilities were integrated. The economic indices for the entire bureau were improved to a substantial extent. An additional income of more than 1 million yuan was obtained merely through investigating thefts, plugging leaks and technical transformation. The Qingtongxia Hydroelectric Power Station dealt firmly with weak links in production techniques and organized a rush machine repair group to guarantee safe and full output by all the equipment in the plant. The amount of water in the Huang He during last year's high-water season was the lowest over the past 3 years. The excellent equipment situation, well-organized production and careful operation by the employees permitted a increase of more than 100 million kWh in power generation compared with the same period in the previous year and created the highest historical record for the same period.

The bureau also made full use of correction of professional guiding ideology in construction of the Dawukou Power Plant, a major project in Ningxia. They made great use of voting, single item responsibility, bonuses for work completing ahead of schedule and other forms of contractual responsibility systems and economic measures. The primary party and government leaders in the bureau changed their working styles and resolutely worked an average of one day per month on site, giving face-to-face directions. By the end of December 1984, the main plant building had been completed and the turbines and boiler shells were in place. Other projects have entered the stage of urgent installation. Some 50 million yuan in project investments were completed during the year, 4 percent more than planned.

12539

CSO: 4013/92

POWER NETWORK

BRIEFS

SHANDONG 1984 POWER PRODUCTION--In 1984, the electric energy production of power grids across Shandong Province was over 22.27 billion kWh, or 1.9 billion kWh more than that of the previous year and prefulfilling the target set in the Sixth Five-Year Plan by 1 year. The per-capita labor productivity of power construction enterprises topped 10,000 yuan. [Summary] [Jinan DAZHONG RIBAO in Mandarin 14 Mar 85 p 2 SK]

NINGXIA-GANSU 330KV LINE BEGUN--In mid-November [1984], work officially got underway on the Jingyuan-Gucheng 330KV high-tension power transmission line that will link the Ningxia and Gansu power grids. The transmission line, with a total length of 137 kilometers, will link Gucheng, Zhongning County, Ningxia, with Jingyuan in Gansu Province. When finished, the line will enhance the stability and reliability of the operation of the Ningxia grid. The bulk of the first-stage preparation work has been completed and an all-out effort will be made to have the project completed by the end of 1986. [Excerpts] [Yinchuan NINGXIA RIBAO in Chinese 27 Dec 84 p 1]

CSO: 4013/111

HYDROPOWER

SICHUAN'S SMALL-SCALE HYDROPOWER BOOSTS RURAL ELECTRIFICATION

Chengdu SICHUAN RIBAO in Chinese 30 Jan 85 p 1

[Article: "Making a Contribution To Accelerate Rural Electrification; Sichuan's Rural Hydropower Stations Now Number More Than 7,000"]

[Text] Sichuan's rural hydropower construction is growing by leaps and bounds. According to statistics from relevant departments, last year 284 new small-scale rural hydropower stations went into production and 396 new generators were installed with a capacity of about 68,000 kilowatts, more than one-third above the original plan. This supplemented the new regenerated energy sources for the development of Sichuan's agriculture, local industry, and village enterprises. The rural grand total province-wide now includes over 7,700 small-scale hydropower stations, with 9,491 generators with an installed capacity of more than 1.1 million kilowatts; high tension transmission line total has exceeded 93,000 kilometers, low tension transmission line total has exceeded 333,000 kilometers; the capacity of electrically-powered irrigation equipment is over 1.18 million kilowatts. Last year, the capacity for local electric power generation of all rural small-scale hydropower was 3.5 billion kWh, an increase of approximately 7 percent over the previous year.

Last year, localities in Sichuan strengthened leadership in small-scale hydropower construction, and concerned departments at all levels actively adopted measures to accelerate rural electrification. Placing emphasis on small-scale hydropower construction, the cities and localities of Chengdu, Wanxian, Leshan, Ya'an, and Ganzi added over 8,000 kilowatts in newly installed generator capacity; and in placing emphasis on electrical network construction, the cities and localities of Chongqing, Fuling, Mianyang, Nanchong, Daxian, and Neijiang built over 500 kilometers of power transmission lines. The results of 12 rural electrification pilot counties in power construction, popularizing rural use of electricity, developing the use of electricity for domestic uses, and promoting the development of local industry and village enterprises are obvious. Today, local areas are implementing the policy of the Central Committee concerning "state, enterprise, collective, and individual get together; large, medium, and small rise together", mobilizing the initiative of all areas to engage in electrification and promote the further development of small-scale hydropower construction.

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CSO: 4013/98

HYDROPOWER

BUILDING OF TONGJIEZI WILL GREATLY EASE SICHUAN'S POWER SHORTAGE

Chengdu SICHUAN RIBAO in Chinese 24 Jan 85 p 1

[Commentary]

[Text] Following the completion and start-up of the Gongzui Power station and 2 years of comprehensive preparations, construction now has begun formally at the Tongjiezi Hydroelectric Power Station, another key state hydroelectric power construction project in Sichuan. This is very good news for energy resource construction in Sichuan, and we warmly congratulate those who are building the project.

Hydroelectric power is the main direction of attack for developing electric power in Sichuan. The province has rich hydropower resources, with reserves of more than 140 million kW, the highest in the nation. Few places in the world have such large usable and developable hydropower resources. Rapid development and utilization of these rich hydropower resources gives Sichuan an enormous advantage in economic development and is also the basic route to solving the energy resource shortage in our province. Completion of the Tongjiezi Hydroelectric Power station will add a new primary electricity resource for Sichuan. This is of extremely strategic importance for accelerating energy resource construction in Sichuan and guaranteeing the achievement of a quadrupling of the gross value of industrial and agricultural output by the end of the century, as well as for economic construction in the southwest and modernization of national defense, and for national energy resource construction. The employees of the Seventh Engineering Bureau of the Ministry of Water Resources and Electric Power who are responsible for building the project have been providing electricity for the people of Sichuan in the deep gorges along the Dadu He for years. They overcame repeated difficulties like communications problems, materials shortages and extremely complex geological conditions. They began doing a large amount of preconstruction preparatory work for the project in 1978 and have created excellent conditions for formally starting construction of the project. Their hard work to develop hydropower in Sichuan will go down in the annals of the history of hydroelectric power construction in Sichuan. Their glorious achievements in creating wealth for all of Sichuan should receive the thanks of all the people of the province. We would like to express our sincere solicitude and highest

consideration to all the workers and engineering and technical personnel of the Seventh Engineering Bureau of the Ministry of Water Resources and Electric Power and to tell them that we confidently look forward to the stream of good news concerning their future construction.

Construction of the four modernizations is a comprehensive and great undertaking. Key construction projects like the Tongjiezi Hydroelectric Power Station are both labor-intensive and technology-intensive. They involve more than the enormous amount of manpower, materials and capital that the state must invest. Even more necessary is assistance and coordination from all aspects of society. Complete success in construction of this hydroelectric power plant is impossible without assistance from all aspects. The cause of making the entire province wealthier should be taken up jointly by all the people of Sichuan. We hope that all related departments and regions will be full of warmth in assisting key construction during the construction of this key project and guarantee smooth progress in the Tongjiezi project. We believe that with the cooperative efforts of the people of Sichuan, the builders in the Seventh Hydroelectric Power Engineering Bureau certainly will be able to make the formal start of construction on the Tongjiezi project a new starting point for careful organization and construction to guarantee quality and pay attention to overall social results, and to strive to shorten the construction period and launch a new attack on energy resource construction for the motherland.

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CSO: 4013/92

HYDROPOWER

POWER TUNNEL PROJECT FOR TIANSHENGQIAO GETS UNDER WAY

Nanning Guangxi Regional Service in Mandarin 1130 GMT 27 Mar 85

[Excerpts] The water tunnel for diverting water for the Tianshengqiao hydroelectric power station, which will be the longest tunnel in China and is a major state project, was formally started on 18 March by a 10.8-meter diameter super excavator.

Located on the Guangxi-Yunnan border, the Tianshengqiao hydroelectric power station will be powered by water from a nearby river. Therefore, we must excavate a 10.8-meter diameter and 60-li-long water tunnel, China's largest in terms of length and diameter. The amount of soil to be excavated totals 3.6 million cubic meters. If we were to form this excavated soil into square blocks of 1 square meter each, these blocks would stretch from Guangzhou to Harbin.

Due to complicated geological conditions and the limited time for the project, it will be far more difficult than the dam of the hydroelectric power station.

In order to expedite the pace of construction, a super excavator was imported from the (Ampex) Company of the United States last November. Weighing 1,600 tons, this excavator measures 150 meters in length and has 2,400 horsepower. It can excavate 1.8 meters an hour, or move 160 cubic meters of rock. It is a sophisticated machine requiring high skill for installation.

With coordination by our technicians and the American experts, they overcame such difficulties as poor installation equipment and limited space for installation. They took only 50 days to accomplish the task. One of the U.S. experts said that with modern installation equipment, it had taken 90 days to install this machine in the United States.

CSO: 4013/111

HYDROPOWER

THE DEVELOPMENT AND USE OF HUBEI'S SMALL-SCALE HYDROPOWER

Wuhan HUBEI RIBAO in Chinese 23 Jan 85 p 4

[Article by Li Huawen [2621 5478 2429], Deputy Chief Engineer, Hubei Province Water Conservancy Department]

[Text] Hubei is located in the middle reaches of the Chang Jiang. It has a warm climate with ample precipitation, contains many mountains and rivers, and has extremely rich hydropower resources. Besides the Chang Jiang and Han Jiang, Hubei also has 1,193 medium and small rivers scattered across 64 counties. There are more than 7 million kW in small-scale hydroelectric power reserves, more than 4 million kW of it developable resources, fifth in the nation. This is Hubei's energy resource advantage. A major problem in Hubei is the shortage of quality coal and insufficient amounts of oil and natural gas. This situation makes the development of small-scale hydroelectric power even more important. Although Hubei began constructing small-scale hydroelectric power stations in the 1950's and had built more than 2,800 sites on a preliminary scale up to the end of last year, it is very backward in comparison with such southern provinces as Fujian, Zhejiang, Jiangxi, Guangdong, Guangxi, Hunan, Yunnan, and Guizhou. We should resolve to catch up.

Small-scale hydroelectric power has a lot of advantages. It is a healthy, cheap and renewable energy resource found at many locations over a large area and is suited to the special characteristic of distributed loads in vast mountainous regions. Hydropower is easier to convert to electricity than solar energy or wind energy, requires fairly low investments per unit of effective electrical power and is a mature technology. The development of small-scale hydroelectric power can solve the problem of growing difficulties in obtaining fuel in rural areas and isolated regions without polluting the environment. Why has it developed too slowly? The main reasons were that total investments and investments per kWh were too high, the development was restricted by water sources and contradictions between several water-using departments, there was a lack of synchronization between electricity use loads and hydrological conditions, and there was a failure to coordinate management systems. How can these problems be solved? I feel that consideration should be given to several aspects: 1) Development and comprehensive utilization; 2) Standardization and systemization of small-scale hydroelectric power station design to gradually achieve finalization of designs by classes; 3) Extending new materials and construction methods suited to small-scale hydroelectric power stations;

- 4) Solving problems related to ownership of electric power stations, capital collection, maintenance, cost rates (fee collection standards, interest rates on deposits, etc.), time periods for loan repayment, administrative management, capital construction procedures, and so on, to stimulate their active implementation in electricity production; 5) Strengthening training of specialized personnel and managerial personnel, strengthen safeguards; 6) Making planned improvements in electric power station regulation capacities, supplementing water resources, improving reliability in electricity supplies and so on.

The development of small-scale hydroelectric power first of all should determine the utilization of small-scale hydroelectric power to learn the scale and nature of the problem. Based on the actual conditions in Hubei, small-scale hydroelectric power can assume responsibility for providing energy resources for rural electrification in some counties, cities and districts to provide electricity for processing agricultural and sideline products, small-scale drainage and irrigation, rural and small town enterprises, county-run industries and the people's livelihood to reduce or eliminate the need for the state to ship large amounts of hydrocarbons (diesel fuel, gasoline, etc.) to rural areas. All active elements should be stimulated in the area of forms for developing small-scale hydroelectric power. The province, prefectures, counties, districts, villages, the state, collectives and individuals can become involved. Collect capital and shares from many areas, expand financial resources and accelerate the pace of small-scale hydroelectric power construction. We also can invite economically-developed regions to invest in shares for joint management of small-scale hydroelectric stations in the mountainous areas of western Hubei where hydropower resources are abundant. The electricity can then be regulated and utilized through the national power grid to increase the amount of electricity they use and promote economic development in these regions. Small-scale hydroelectric power should resolutely adhere to the principle of "the builder is the owner, the manager, and the one who receives the benefits." Ownership rights over small-scale hydroelectric power should not be changed and should be protected by law. Long-term low interest loans should be extended to speed up development. Concentrate on management of capital construction, advocate competition, shorten construction times and lower construction costs.

Small-scale hydroelectric power utilization should be based on the special characteristics of Hubei and studies of seasonal electricity utilization from small-scale hydroelectric power and improved results of hydroelectric power. Consider Hubei's mineral resources and build several high-consumption regular annual loads and seasonal loads such as baking Hubei's rich phosphoric rock to make calcium-magnesium-phosphorous fertilizer or making yellow phosphorous. In this way, hydropower and mineral resources will be integrated and small-scale hydroelectric power will express even more of Hubei's special characteristics.

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CSO: 4013/94

HYDROPOWER

BRIEFS

BAOZHUSI UPDATE--In order to accelerate the pace of power construction and the development of agriculture and industry in Sichuan Province, the State has formally approved the construction of the Baozhusi Hydroelectric Power Station in Guangyuan County. Today, the construction workers are on the site and 1985 will be the year for the project's preparation stage. The Baozhusi Hydroelectric Power Station is mainly an electricity generating project but will also serve flood control, irrigation, and log transportation. Four generators will be installed for a total installed capacity of 640,000 kilowatts and a yearly output of 2.3 billion kilowatt-hours. The Northwest Planning and Design Institute of the Ministry of Water Resources and Electric Power is handling the design work and the Ministry's Fifth Engineering Bureau is responsible for the construction. Total investment will be 900 million yuan and construction time will be 10 years, with the first generator slated to go on stream in the 8th year. [Text] [Chengdu SICHUAN RIBAO in Chinese 4 Mar 85 p 1]

WORK BEGINS ON SHANGBIAO--Following approval by the provincial Economic and Planning Committee on 29 January, work on the first cascade of the Shangbiao Hydroelectric Power Station, a joint investment project involving local and central authorities, officially got under way on the 30th. The Shangbiao hydropower station is being built on the border of the Jingning Yuzu Autonomous Xian and Shouning Xian in Fujian Province, at an elevation of 1000 meters above sea level. The station will have an annual power output of 36 million kWh and be built at a cost of 16.7 million yuan. This year's investment will be 3.5 million yuan, divided 50-50 by the province and the central authorities. [Excerpt] [Hangzhou ZHEJIANG RIBAO in Chinese 31 Jan 85 p 1]

CSO: 4013/108

THERMAL POWER

SICHUAN TO BUILD THREE BIG THERMAL POWER PLANTS

Chengdu SICHUAN RIBAO in Chinese 1 Mar 85 p 1

[Text] In order to reverse the situation of chronic power shortages in the province, Sichuan's provincial government, with assistance from the Ministry of Water Resources and Electric Power and other related departments, is tackling the development of electric power in a big way. For 3 months prior to February of this year, the Electric Power Planning and Design Institute of the Ministry of Water Resources and Electric Power made on-the-spot investigations of the feasibility study reports made by the Southwest Electric Power Design and Planning Institute for three large-scale thermal power plant projects.

The three big backbone thermal power plants Sichuan Province wants to build are the Luohuang Power Plant in eastern Sichuan, the Huangjue Power Plant in southern Sichuan, and the Jiangyou Power Plant in western Sichuan. The first two involve new construction while the third is an expansion project. The total installed capacity is 3.3 million kilowatts and the power is to be transmitted by 220KV and 500KV transmission lines; 1.2 million kilowatts should be available within the period of the Seventh Five-Year Plan.

Initial-phase work on these three thermal power plants began more than 10 years ago. Following the 12th Party Congress, close attention was paid to power plant construction feasibility study reports, and on the basis of the topographical and geological conditions, coal and water resources, rail links, atmospheric environmental protection aspects, and land acquisition for each of the three plant sites, a more detailed plan emerged for comprehensive arrangements and equipment selection. The Electric Power Planning and Design Institute of the Ministry of Water Resources and Electric Power, through an investigatory process, has produced rich and refined suggestions on reducing costs, shortening construction time, and increasing economic benefits.

CSO: 4013/110

29 April 1985

THERMAL POWER

HEILONGJIANG EMBARKS ON AMBITIOUS POWER PLANT CONSTRUCTION PROGRAM

OW131132 Beijing XINHUA in English 1045 GMT 13 Apr 85

[Text] Harbin, 13 Apr (XINHUA)--Heilongjiang Province has started construction of two power plants with a total generating capacity of 1 million kilowatts, an official at the provincial bureau of power industry said here today.

In addition, the province is preparing to start construction work later this year on the Jiamusi and Liangzihe power plants, which will have a combined capacity of 300,000 kilowatts.

Power schemes nearing completion include a generating unit with a capacity of 100,000 kilowatts at the Mudanjiang No 2 Power Plant, and a 225,000-kilowatt power plant in the Daqing oil field.

They are scheduled to go into operation in the second half of this year.

Over the past 4 years, Heilongjiang has installed generators with a total capacity of 900,000 kilowatts. Its electricity output in 1984 was 37.3 percent more than in 1980, the official reported.

However, electricity supply is still failing to meet both industrial and agricultural demand.

The province plans to install power-generating facilities with a total capacity of 3,200,000 kilowatts during the Seventh Five-Year Plan from 1986 to 1990. This figure exceeds its entire existing capacity.

To accelerate the construction of power stations, the province has collected funds from various local production sectors to swell state allocations.

In addition, five 220KV transmission lines, totalling 587 kilometers in length, are also under construction. Transmission lines with a total length of 1,300 kilometers have been installed over the past 4 years.

CSO: 4010/129

THERMAL POWER

AGREEMENT FOR 700MW SHAJIAO PLANT SIGNED, COMPLETION SET FOR 1988

HK1000205 Beijing CHINA DAILY in English 10 Mar 85 p 2

[By Staff Reporter Zhang Chuxiong]

[Text] Guangzhou--A contract for the joint development of Shenzhen Shajiao Coal-fired Power Plant was signed here this week by the Shenzhen Special Economic Zone Power Development Company and Hopewell Power (China) Ltd. of Hong Kong.

The 700,000 kilowatt project was negotiated in the first half of 1984 and a preliminary agreement was signed by both sides last June. The contract was approved by the State Council last month.

The power plant will be one of the largest foreign investments in Guangdong Province. It is scheduled to be completed by 1988 and is expected to contribute significantly to advancing development of the power industry in the province.

Zhou Qiwu, deputy mayor of Shenzhen Municipality, told CHINA DAILY that according to the contract, the zone's power company will provide land construction and will supply coal from Shanxi Province. Electricity produced by the plant will be purchased with foreign currency. The Hong Kong partner will invest 900 million yuan in the project.

The joint venture will last 10 years, with the Hong Kong side reaping 80 percent of the profits as repayment of the investment. Beginning in the 11th year, the plant will be turned over to the Shenzhen power company which will manage its operation for another 15 years, Zhou said.

The Hong Kong investor is a consortium of Hopewell China Development Ltd., China Development Finance Co., Hong Kong Ltd., Kanematsu-Gosho Ltd. of Japan, Yue Siu Enterprises Ltd., and Shum Yip Development Company Ltd., of Hong Kong.

Hopewell Construction Company Ltd. of Hong Kong will be responsible for the construction work on the project, the mayor said.

CSO: 4010/102

THERMAL POWER

WORK PROGRESSING RAPIDLY ON XIAOLONGTAN NO 2

Kunming YUNNAN RIBAO in Chinese 7 Jan 85 p 1

[Article: "The Xiaolongtan No 2 Power Plant Construction Project Is Progressing Rapidly and Quality is Good"]

[Text] The big 6,000-man army that is responsible for building the Xiaolongtan No 2 Power Plant construction project has achieved speed through reforms and guaranteed quality, and is fighting to put the first 100,000 kW generator set into operation by October 1985.

More than 172,000 cubic meters of soil and rock had been excavated up to the end of last year at the Xiaolongtan No 2 Power Plant project. Some 140 meters of a smokestack designed to be 180 meters tall were completed and they are now moving upward at the rate of 3 to 4 meters per day. The 4.4-km-long suspended structure of the conveyer system used to transport coal and the 32-meter-high coal pourer and ash tower stand loftily. Newly built employee residences, hospitals, and schools are now springing up everywhere. The entire project has completed a total of more than 129 million yuan in investments.

In order to speed up construction of the power plant, the party group at the Yunnan Electric Power Bureau decided in August of last year to carry out system reforms in the Thermal Power Construction Company. They established an on-site corporation, simplified structures and changed the old four-level management system into three-level management, established a solid position responsibility system for all personnel, implemented contractual responsibility and inspired the employees. During construction of the main plant building and smokestack of the power plant, they sent backbone technical cadres to Sichuan, Shaanxi, Jiangsu, and other areas to study. They guaranteed that there would be no accidents in the very hard-to-build smokestack and the quality met state standards.

In order to assure the progress of construction of the power plant, most of the employees of the Yunnan No 1 Construction Company gave up their days off and worked day and night to complete more than 9.3 million yuan in investments last year. They adopted several technical measures to deal with difficulties caused by construction in areas with swelling ground to guarantee project quality and speed.

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CSO: 4013/94

THERMAL POWER

BRIEFS

HEMENKOU POWER PLANT EXPANSION--The Hemenkou Power Plant sits on the banks of the raging Jinsha Jiang. As we enter the plant area, we see the overhead tramway lines, the coal conveyor towers rising up, five boilers over 40 meters tall, and the multi-story control building. This plant has a total installed capacity of 150,000 kilowatts, producing 2.2 million kilowatt-hours daily. It is the largest electric power supply base in the Panzhihua area. Recently the 3,000 steam condensing tubes in the generation equipment were replaced. Previously this took 38 days; this time it took 18. The acceptance test showed it to be first quality work. In operation for 16 years, this plant surpasses its targets every year. It has been praised by the Ministry of Water Resources and Electric Power as being the most advanced unit in the nation for economy; the total workforce to production ratio averages 50,000 yuan. A new 50,000-kilowatt generator unit is now under construction. The workers are busy here from day to night. At Hemenkou, a new plant and a new breed of men are rising up to the same beat. [Excerpts] [Chengdu SICHUAN RIBAO in Chinese 10 Sep 84 p 2] 12663

ZHANGPING UPDATE--Ground was broken today [15 February] on the main power house of the Zhangping thermal power plant, an urgent construction project for Fujian Province. This thermal power plant will have two 100,000 kW generating units that will supply electricity to the Xiamen Special Economic Zone and the Ying-Xia electrified railroad. The No 1 generator should be installed by the end of next year. Working day and night for the last 3 months, the Provincial Thermal Power Engineering Company, the outfit responsible for the project, has excavated some 210,000 cubic meters of earth and rock. [Excerpt] [Fuzhou FUJIAN RIBAO in Chinese 16 Feb 85 p 1]

CSO: 4013/107

COAL

MINISTRY URGES COASTAL CITIES TO BUY COAL FROM PEASANT MINES

OWO81936 Beijing XINHUA in English 1627 GMT 8 Mar 85

[Text] Fuzhou, 8 March (XINHUA)--China's open coastal cities should buy more coal from peasant-run mines and improve transport to help ease their annual fuel shortages, the Ministry of Coal Industry said here today.

The cities have reported shortages of 10 million tons of coal a year. The energy crisis cut their annual output value by about 10 billion yuan, according to municipal representatives.

To make up the shortfall, the ministry will urge state-owned mines to produce more and to purchase coal from rural pits. The measures will make an extra 9 million tons of fuel available to the coastal cities this year, officials said.

The ministry will also build up a barge fleet on the Chang Jiang, build a new port on the inland waterway and invest in upgrading a railway to help move more coal from mines in Henan, Shanxi, and Shaanxi Provinces to the coast.

It has further plans to set up a joint venture transport company in cooperation with Tianjin Municipality and a Japanese firm. The company will have 16 vessels and 300 15-ton trucks, the officials said.

CSO: 4010/102

COAL

JILIN MINES 4 MILLION TONS OF RAW COAL IN 1984

Changchun JILIN RIBAO in Chinese 25 Jan 85 p 1

[Article: "Reform Brings Vitality to Enterprise; Jilin Local State-run Coal Mine Coal Output Creates New Record Last Year"]

[Text] By paying attention to promptly resolving new problems that appeared during the reform, the Jilin Coal Company brought new life and vitality to the enterprise. Last year, production of raw coal by the local state-run coal mines province-wide was 4 million tons, exceeding the plan by 590,000 tons, an increase of 550,000 tons over 1983, reducing losses by 2.3 million yuan, all of which created the highest level in history.

In 1982, the coal mines subordinate to Jilin Province signed a 3-year financial loss contract with relevant departments of the province. At the beginning of last year, focusing on problems in the contract, the province made two revised stipulations which mobilized the initiative of the enterprises. Three coal mines which signed the contract last year produced 1.234 million tons of coal, 20.5 percent more than the previous year, while prices of raw materials were rising, coal losses per ton dropped from 11.04 yuan to 10.02 yuan. Heilong and Shensonggang coal mines both overproduced by over 60,000 tons, receiving subsidies of over 1 million yuan. Focusing on the variety of distribution systems among local coal mines, problems of the uneven management results, and study of coal mines with uniform distribution, beginning in the last half of the year, a per ton wage distribution system was implemented comprehensively to link directly coal output with the interests of the individual and the collective and obtain clear results in increasing output and lowering costs. In the last half of the year, coal output reached 1.44 million tons, an 18.4 percent increase over the first half of the year. In six of the province's seven regions, losses per ton of coal declined by varying degrees. Tonghua and Changchun regions declined 36 percent and 27 percent, respectively, and five of 35 coal mines turned from losses to profits. Last year, the province's local state-run coal mines reduced losses by 2.3 million yuan more than the plan.

8226

CSO: 4013/98

COAL

NEW NEI MONGGOL FIELD BEGINS PRODUCTION

OW211037 Beijing XINHUA in English 0820 GMT 21 Mar 85

[Text] Hohhot, 21 March (XINHUA)--Low-ash quality coal is now rolling out of the Dongsheng-Shenmu coal field on the Shaanxi-Inner Mongolia border.

The coal field's first shipment of 10,000 tons was taken to Baotou for transshipment to energy-short Liaoning, Shandong, and Jiangsu provinces.

The coal field is located at Shenmu and Fugu in northern Shaanxi and the Ih Ju League in Inner Mongolia. It covers 12,000 square kilometers and has estimated reserves of nearly 100 billion tons. With an ash content of about 2 to 5 percent and low sulphur and phosphorus levels, the coal can be used in chemical plants and railway locomotives and is an ideal replacement for the boiler-consuming heavy oil.

When completed, the Dongsheng-Shenmu field will be China's second largest quality coal producer after Datong in Shanxi Province.

It will produce about 300,000 tons this year, with planned increases to 5 million tons by 1990 and 10 million tons by 1993.

CSO: 4010/112

COAL

INCREASED WESTERN FUJIAN COAL PRODUCTION BOOSTS GROWTH OF INDUSTRY

Fuzhou FUJIAN RIBAO in Chinese 5 Sep 84 p 2

[Excerpts] After 30 years of bitter struggle, the Longyan area has become a coal production base for Fujian Province. Last years' production of raw coal was 2.57 million tons, or 51 percent of Fujian's total production. This is a 388-fold increase over 1949. More than 1.8 million tons of coal was supplied to Fuzhou, Xiamen, southern Fujian, eastern Guangdong, and Jiangxi. Today, 1 day's production is about the same as a whole year's production before liberation.

Western Fujian has rich coal resources, most of it top quality anthracite; Zhangping is the only area in Fujian that produces bituminous coal, with reserves of 530 million tons. Before liberation, because exploration and mining techniques lagged behind, and because transportation was difficult, these excellent conditions were not exploited, and annual production was a mere 6,000 tons. With the establishment of the new China, the party and government paid stricter attention to the development of the coal industry in western Fujian, and invested large amounts of capital in the Longyan, Yongding, Zhangping, Liancheng, and other county- (or city-) run local coal mines. They built the Zhangping-Longyan railroad and the Longyan-Kanshi railroad in the coal region. They brought equipment and talent from the old coal bases in Shandong, Shanxi, and Anhui to serve as the foundation for the development of the western Fujian coal industry. During the Second Five-Year Plan, the state constructed four large provincial coal mines: Hongmeishan, Subang, Zhangping, and Yongding. Underground ventilation and water drainage were mechanized, as well as the elevators and transport.

Since the Third Plenary Session of the 11th Party Congress, peasant-operated coal mines have been encouraged and supported in the Longyan area; cooperatives and peasants have been given a free hand at mining thin beds and leftover coal. There are 298 village- and town-run mines in the area, making use of 2.53 million yuan in interest-free loans and subsidies; techniques are being upgraded, galleries repaired, and the production of raw coal has taken a rather sharp turn upward. Last year over 550 united or specialized family coal pits were developed, producing over 300,000 tons of coal. In the first half of this year the principal sectors concerned have stepped up technical direction for peasant-operated coal mines, provided information on funding, cultivated administrative talent, helped in selling coal; creating an impetus for peasant-operated coal mines. In Liancheng and Wuping counties alone there are over 200 new peasant-operated coal pits.

The development of the coal industry promotes and spurs the development of other industries. Throughout the area, heavy and light industries such as electrical, mechanical, metallurgical, papermaking, spinning, cement and chemical have all sprung up from nowhere or grown from small to large. In particular there are the small and medium chemical fertilizer plants which use coal as a fuel and a raw material. There are now eight of them with an annual production of over 154,000 tons of chemical fertilizer, shipping ammonium carbonate to points in the province and beyond. Today the Longyan area has become a prototype for independent industrial systems, laying down a solid foundation for even greater development now and in the future.

12663

CSO: 4013/26

COAL

LOCALLY OWNED MINES PRODUCE ALMOST A QUARTER OF NATION'S TOTAL

OW230800 Beijing XINHUA in English 0735 GMT 23 Mar 85

[Text] Beijing, 23 March (XINHUA)--Coal mines run by rural collectives or peasants are furnishing nearly a quarter of the nation's output, according to a senior official at the Ministry of Coal Industry today.

Such mines, now numbering 50,000, produced 29.85 million tons in the first 2 months of this year, accounting for 23.9 percent of the country's total, said Yang Yongren, deputy manager of the ministry's United Local Mine Service Company.

Coal mines in China are either state-run or locally run. Among the latter group--10,000 of which are run by individuals--2,000 have an annual capacity of producing over 30,000 tons each. Some of them turn out more than 300,000 tons a year.

Between 1980 and 1984, the total output of these mines increased by over 80 percent to 200 million tons, while that of state-run mines by 14.8 percent.

Built with little government investment, but obtaining a quick return and producing increasingly large amounts of coals, these local mines have greatly helped to ease energy shortages in rural areas, Yang said.

Yang attributed the rapid development to the government's new policy of "letting the government, collectives and individuals join hands in building mines."

To guarantee a steady development, the coal ministry had ensured that the local mines had about 35 billion tons of deposits. Peasants are allowed to cut coal from small mines, disused state mines and areas around major mines. They can also run coal transport teams.

However, Yang pointed out, further development would require more technicians and transport facilities.

CSO: 4010/115-F

COAL

IMPACT OF NEW TECHNOLOGICAL REVOLUTION ON CHINA'S COAL INDUSTRY (PART ONE)

Beijing SHIJIE MEITAN JISHU [WORLD COAL TECHNOLOGY] in Chinese No 1, Jan 85 pp 3-8

[Article by Rui Susheng [5360 4790 3932], Director of the Ministry of Coal Industry Scientific and Technical Information Research Institute, and Deputy Chief Engineer Wang Qingyi [3769 1987 0001]]

[Text] The world is now in the midst of a new technological revolution. This trend is very important for modernization and construction in China. What is the relationship between the new technological revolution and the coal industry? What are the developmental trends and tendencies in China and abroad? What policies should China's coal industry adopt to deal with it? This article will provide some background information and offer some rough viewpoints for reference.

There are many explanations in foreign countries for the "new technological revolution" such as the "Third Wave," "postindustrial society," the "third technological revolution," and "fourth technological revolution," and so on. In essence, all of them are assessments and descriptions of the global scientific and technological revolution and its affects on the economy and society. The basic technologies included in the new technological revolution involve four main aspects: information technologies, biotechnologies, new materials and new energy resources.

Modernization and construction in China is being carried out in an international environment of extremely rapid development of science, technology and the world economy and of extremely intense competition. It cannot be completed by closing the country to international discourse. China's developmental references are not our own past but advance world levels. For this reason, all sectors of the national economy should face the world and the future, study countermeasures and meet the challenge.

Energy resources are a primary question in China's economy and coal is the country's primary energy resource. For this reason, the coal industry should be the focus of research on countermeasures for the new technological revolution.

I. The New Technological Revolution and the Coal Industry

1. Coal is the bridge to the world's future enduring energy resource system.

Energy resources historically have been the material foundation and motive force of social development. Each breakthrough in energy resource technologies throughout history has been accompanied by major changes in production technologies, sometimes to the point of engendering a revolution in social production patterns. There have been three major breakthroughs in energy resources in the modern era: the discovery and utilization of the steam engine, electrical power and atomic power. They are accompanied by the two major transitions in the world energy resource structures. The first began in the 1760's with the movement from wood to coal during the era of the steam engine that "caused industry to shake the foundation of the world" (Marx's terms). The second transition began in the 1920's with the movement from coal to oil and gas. This transition has played a major role in modern economic and social development.

Technological progress was the primary factor motivating these changes in energy resource structures. World energy resource structures now are in a new period of change that involves a transition from oil, gas and other nondurable energy resources to an enduring energy resource system based on renewable energy resources (mainly nuclear and solar energy). This new transition is a slow process that may take a century. Mineral fuels will dominate the world's energy resource structure for the next 50 years. Coal will replace oil during this transitional period and once again become the world's primary energy resource. There are several reasons for this. The world has inadequate petroleum energy resources, and coal resources far exceed petroleum and natural gas. Production costs can be lowered by developing open-pit coal extraction. Major breakthroughs will be achieved in coal conversion technologies that will permit large-scale production of synthetic fuels and chemical raw materials that can be substituted for petroleum and natural gas. Oil and gas development must be shifted to frontier regions, the oceans and non-conventional energy resources at ever-increasing cost. The proportion of petroleum in the world's energy structure is now gradually declining, while that of coal is gradually rising. According to predictions from the 12th World Energy Resource Conference in 1983, coal as a proportion of the world's energy resource structure will exceed that of petroleum and move into first place by the early part of the 21st century (Table 1). Predictions based on international applied systems analysis research indicate that world coal output will be triple that of current levels by the year 2030, 56 percent of it being used for production of synthetic fuels that will meet 40 percent of world demand for liquefied fuels.

Coal is, therefore, a bridge to the world's future durable energy resource system.

Table 1. Predicted Demand and Structure of World Demand for Primary Energy Resources, 2000-2020

Item \ Year	1960	1978	2000	2020
Demand for primary energy resources (100 million tons of standard coal)	49.5	102.0	175.5 ~ 151.5	270.0 ~ 207.0
Primary energy resource consumption structure (%)				
Coal	36	25	28	32
Petroleum	29	39	29 ~ 28	20 ~ 18
Natural gas	13	17	18 ~ 17	17
Hydro power	5	6	6	8 ~ 7
Nuclear energy	0	2	8	13 ~ 12
New energy resources	0	0	3	5 ~ 6
Non-commercial energy resources	17	11	8 ~ 10	5 ~ 8
Total	100	100	100	100

2. The coal industry is undergoing a transition from low-level to high-level technologies.

On a world scale, the coal industry historically has been a labor-intensive industry. Technical progress has been slow for a long period. There is heavy physical labor in the mines and efficiency improvements come slowly. The successful testing of fully mechanized coal extraction in the 1950's, however, brought about basic changes in the coal industry and the coal industry in developed nations is now based on a foundation of modern science and technology. The developed nations have rapidly extended new technologies, especially microcomputer technologies, on the basis of fully-mechanized extraction. This has caused the coal industry to begin a transition from low-level to high-level technologies, and the time of complete automation in production techniques is not far off. (Aisila), former director of the Coal Management Bureau in England, considers fully-mechanized coal extraction to be the first technical revolution in the 200-plus year history of the world's modern coal industry. He

feels that the second technical revolution was coal mine automation and that coal gassification and liquification is the third technical revolution.

Technology-intensive industries are also called knowledge-intensive industries or high technology industries, and they have their own special connotations. They refer to industries with a high degree of knowledge intensiveness on the part of the laborers who serve as factors in the forces of production, and where the importance of human resources exceeds that of capital investments. (Hayi Boneisiku) expressed the opinion in the magazine SCIENTIFIC AMERICAN that knowledge-intensive industries have these characteristics: average expenditures for product research are 10 to 12 times those for non-technology-intensive products; one-third of the scientific and technical personnel in non-R&D departments (manufacturing, sales, etc.) with mature common technical graduates have a polytechnical level. Some American scientists have pointed out that only 3 to 5 percent of the total national workforce are high technology industry employees at the present time, and that they cannot rapidly attain the levels of basic industries in terms of employment and value of output.

Obviously, the coal industry in some of the most advanced coal extracting countries still has not attained the level of technology-intensive industries but is still in the process of a transition to a technology-intensive industry.

The transition from low-level to high-level technologies in the coal industry implies that increases in coal output will depend increasingly on scientific and technical progress, and will no longer rely primarily on increased manpower and investments. In the Soviet Union, 90 percent of increased coal output depends on improved efficiency at the present time, while 80 percent of increased efficiency depends on technical progress.

It appears that all major achievements in the new world technical revolution rapidly permeate all spheres of coal extraction, processing, conversion and utilization, and that they not only greatly increase labor productivity in the mines and expand the scope of development and utilization of coal resources, but also conceal new technical breakthroughs that may permit the appearance of new technology-intensive industries like the coal liquification industry.

3. Application of the achievements of the new technical revolution in the coal industry.

From a technological perspective, the coal industry is a very special industry, especially shaft extraction. It involves safe and highly efficient coal extraction in limited underground spaces with a dangerous and adverse environment and continually changing production conditions. Although coal extraction already had become an independent science by the beginning of the 19th century, there still are many profound mysteries that are not understood, such as coal that seriously endangers the lives of mine workers and the mechanics of gas eruptions, that still are at the stage of

speculation. Theories of the mechanical properties of rocks are still at the stage of exploration. Automation in processing industries had been achieved by the 1950's and there are now unattended plants. Automation has just begun in shaft coal extraction. The many variables that must be dealt within the coal extraction industry and the terrible environment make it difficult to achieve completely automated unattended mines even by applying the newest achievements in modern science and technology. This makes the degree of difficulty in extraction technologies used by mine workers far greater than that in surface industries. The achievement of total mechanization and automation of production and construction in coal mines requires high-level technologies in many different specialities.

The gradual drying up of easily extractable coal resources, the continual degradation in conditions and the ever-growing difficulties in coal extraction make the question of improving working conditions even more urgent, and unit investments and production costs have risen. At the same time, the poorer quality of the raw coal and the new demands for the quality of commodity coal and environmental protection are placing higher and higher demands on coal processing and utilization. These factors have promoted technical progress in the coal industry.

Developments in modern coal technologies depend to a very great degree on technologies in other industries, and the new world technical revolution has effectively promoted technical progress in the coal industry. We will outline the current situation and the prospects for the application of new technologies in the coal industry below.

1) Microcomputer and computer technologies.

Microcomputers entered the coal mines at the beginning of the 1960's and brought new life to the aging coal industry. They indicate a new stage of technical progress in coal mines: automation of management and production.

The coal industry in developed countries has now set up management information systems and databases centered on computers. Totally automated management systems used in the Soviet Union's coal industry cover 13 functional systems including production, planning, capital construction, supply, finances, wages, scientific research, design and so on. They have greatly improved work efficiency and quality. The results of setting up departmental information systems in the Soviet Union is that output has increased by 7 to 9 percent while consumption [of energy and materials] dropped by 8 to 10 percent. Management costs dropped by 15 to 20 percent and the investment recovery period is 3.3 years.

There has been substantial progress in the application of microcomputer and computer technologies in coal mine production and construction. The three main areas are design and equipment, systems monitoring and control, and automation.

Computer-aided design and manufacturing systems are now beginning to be used in coal mines. These systems can do stress analysis, automated drafting of diagrams for coal extraction equipment and self-propelled support components, diagrams of the arrangement of valves in hydraulic return loops in supports and hoses and three-dimensional diagrams for arrangement of coal extraction faces and shafts and so on, and they can be used directly as computers for mechanical processing procedures.

Computer monitoring and control systems are now being used in shaft mine production in England, West Germany, the U.S., Japan, the Soviet Union and other countries. The current monitoring and control systems use centralized monitoring and control patterns. Their functions include automatic control of large-scale fixed equipment, environmental monitoring in shafts and data collection, storage and analysis for management. A representative system is the MINOS System in England. This system is located on a surface control platform and the regulation personnel can use calling keys or instruction keys and display screens for man-machine discussions. When dangerous conditions appear, an audible warning signal is emitted with a short English warning and actions that should be taken are given. Data and simulation diagrams are displayed on the fluorescent screen. A report is typed automatically when each shift ends. There were already 35 mines using automated monitoring and control of underground transport systems in 1983. The MINOS system used for monitoring the underground environment uses various beam collection tubes controlled by remote sensing devices and microprocessors to carry out centralized monitoring and automatic alarms.

The first generation of monitoring and control systems were decentralized or partially controlled and used microprocessors to monitor and control each activity, production, link or segment that can be linked into a single system when necessary. This type of system is structurally simple and dynamic. It is very reliable, has a fast transmission speed and can greatly lower investment costs. It is now used in large-scale automated coal dressing plants.

The most difficult computer controlled technologies in coal mines are work face equipment monitoring and control, and there have been new breakthroughs recently. This is the first indication that coal extraction is entering the era of automation. The Model 7000 work face microcomputer control system developed over many years in England was tested successfully below ground in 1983. Moreover, five demonstration models were put into use and have achieved obvious economic results. Automatic procedural control of self-propelled supports is possible with installation of microprocessor controls. Simulation computers transfer information to the surface where it can be entered into colored charts for monitoring and controlling equipment, diagrams of display equipment positions and support movement diagrams.

Fiber optics communication is now being used in mines in West Germany and fiber optic system products for use in mines have appeared in England and Japan. They have the advantages of being broadbanded and high transmission capacity, portability, explosion-resistance and good interference rejection capabilities. They are the ideal information transmission system for automated mines in the future.

2) Machine-computer technologies.

The integration of microcomputer technologies with machinery, electrical engineering, monitoring and testing, control and other technologies has given shape to new machine-computer technologies. Development of these technologies can cause machinery production to leap over traditional developmental stages. It brings about qualitative changes in product functions and the production of a new generation of products like digitally-controlled machine tools, flexible production lines, industrial robots, intelligent instruments, automated office equipment and so on.

Coal mines require many types of non-standard equipment. There now is a trend in developed nations toward supplies of special-use coal extraction machinery for a single mine or even a particular coal seam. Digitally-controlled machine tools and flexible production lines permit the production of machine equipment for mine use according to many types and specifications at fairly low cost.

The trend in instruments is toward miniaturization, digitalization and intelligence. There are many types of mine safety instruments and various types of equipment and instruments used for remote sensing and automation, and new products are appearing constantly. The sensors used in England's work face microcomputer control system include natural gamma sensors, pick stress sensors, top plate height sensors, optical coal extractor location sensors, coal wall base angle sensors and work condition sensors for coal extraction machinery. All nations are now using anti-explosive laser direction instruments in their mines. Japan has developed a semiconductor laser (0.1 microwatt) gas sensor that uses an optical fiber (1,000 meters long and 125 micrometers in diameter) for a transmission line. Ground noise monitors are now in use on 600 work surfaces in 61 mines in the Soviet Union to forecast coal and gas eruptions and mine shocks. The sensor transmits the recorded information to a surface control platform. Infrared CO analyzers are now used widely in West European countries to predict fires in mines, with more than 1,000 in use in England.

3) New materials.

The new materials related to the coal industry mainly are high-performance alloys, engineering plastics, synthetic resins, high-performance compound structural materials, fiber optics, sensitive materials used in sensors and others.

Among the high-performance alloys, the greatest progress has occurred in widely-used drilling tool materials. Drilling rods used in rock drilling rigs in Sweden have a useful life of 3,000 to 6,000 meters and the pistons have a useful life of 60,000 meters. The spherical diamond drill bit that recently came on the market can replace traditional flat-shaped hard alloy drill heads. Silicon nitride compound materials are a drill bit material with a good future.

There have been improvements in the quality of materials and manufacturing techniques for coal extraction machinery that have greatly improved reliability and lengthened their useful life. The circular chains used in heavy work face plate conveyors in West Germany could transport an average of 30,000 tons of coal per completed circuit in the early 1960's. This amount now has reached 1 million tons of coal with a continuous chain. The useful life of hydraulic pumps and hydraulic motors used in coal extraction equipment now exceeds 1,000 hours, while the useful life of gears has reached 5,000 hours.

The adoption of aluminum alloy skips to replace steel skips in extraction is a reliable path to increased output for transforming old mines. The weight to effective load ratio of the aluminum skips is 0.56 to 0.75 that of steel skips.

High temperature materials are a key to improving the thermal efficiency of high combustion turbines. Current working temperatures are no higher than 900° C and thermal efficiency is 30 percent. Silicon nitride, silicon carbide and other high temperature structural ceramic blades can operate under temperatures as high as 1,400° to 1,600° C. The main problem is brittleness, and it is predicted that there will be breakthroughs in the 1990's.

There are broad routes for utilization of synthetic resins and engineering plastics in coal mines. Coal mines in the U.S. are installing 36 million resin anchors each year, equal to 30 percent of total annual anchor usage. Coal mines in West Germany are using ployamine resins to strengthen coal walls, top plates and the rock walls of passages, consuming 16,000 tons in 1981. Wear-resistant and anti-corrosive engineering plastics are in wide use for water drainage pipes and coal dressing equipment. The useful life of screen plates made of wear-resistant is four times that of those made with steel. Special ceramics also are being used in coal mines. The U.S. is using alumina ceramics for chutes, coal bins and hopper liners and aluminum carbide ceramics for making pumps and rotary flow meter liners.

4) Biotechnologies

There are a broad range of applications of microbiological technologies in coal extraction and processing.

The Soviet Union, the U.S. and other countries are now studying microbiological coal extraction techniques. Pumping microorganisms and nutrients through drill holes into coal seams causes the coal to decompose into low molecular products that can be transmitted to the surface using compressed air. This is one of the routes to unattended coal extraction in the future. The U.S. Gas Technology Research Institute is experimenting with the use of microorganisms to transform peat as a substitute for natural gas (methane).

The Soviet Union, England, India and other nations are experimenting with the use of microorganisms to lower the gas content of coal seams. Bacteria suspended in hydraulic fluid are injected into the coal seam, oxidizing the

CH in the pores of the coal at low temperatures. Preliminary experiments in mines show that the gas content of coal seams can be reduced by 65 to 70 percent and that gas output at the work face can be reduced by 50 to 60 percent.

The U.S. has carried out industrial experiments on bacterial desulfurization of coal. There are acidophilic bacteria capable of oxidizing iron and sulfur in coal that contains pyrite that can be used for desulfurization. *Bacilla* that oxidize iron and sulfur also can be used for desulfurization. Experiments have shown that the use of bacteria in coal removes 49 percent of the sulfur in pyrite and that the use of *Bacilla* that oxidize iron and sulfur removes 83 percent of the sulfur in pyrite.

5) Aerospace technologies

The aerospace industry is among the most rapidly developing high technology industries. The U.N. Space Commission has pointed out that the utilization of space technologies is one route for economic development in developing countries that permits them to step over certain traditional developmental stages of the developed nations and obtain enormous economic results. The ratio of investments to results in America's aerospace industry is 1:14.

Utilization of satellite photographs for geological surveys of coal fields can greatly reduce fieldwork and conserve on capital. The U.S. is now using satellite remote sensing technologies to explore shallow fault and fracture zones in underground coal mines for investigating impending roof falls and improving mine shaft design. Satellite photographs also are being used for monitoring extraction and reclamation work in open-pit mines.

NASA in the U.S. has been charged by the Department of Energy with applying new achievements in aerospace technologies and studying ways to solve major technical problems in coal production and utilization, include automated coal extraction, computer simulation technologies, underground environmental monitoring technologies, new techniques for burning coal, and so on.

4. Coal extraction technologies of the future.

According to predictions by foreign experts concerning shaft extraction, it is possible that computer-controlled automated mines may appear before the end of the century. It is possible to imagine that new coal extraction technologies during the first 25 years of the 21st century will be based on chemical and biochemical technologies, meaning underground coal gassification and chemical extraction of coal.

1) Computer-controlled automated mines.

Modern shaft coal mines have deep shafts and involve a comprehensive system of many work procedures between work face and ground surface car installation points. For this reason, all work procedures should be mechanized prior to the achievement of automation. Computer control is not predicated

on automation, but coal seams are three dimensional targets and have complex and varied extraction conditions. This makes computer control extremely difficult and also requires the development of many types of sensors.

The situation in automated shaft mines in the year 2000 as envisaged by experts in England would be one of complete automation of extraction, digging, transport and dressing with workers involved only in support, installation, disassembly, maintenance and other subsidiary work. There will be total computer control of the production process using electromagnetic, ultrasound, isotopic and other sensors for data inspection, using lasers to monitor gas and guide machinery, using televisions to monitor equipment operation, analyzing coal quality with isotope instruments and using optical fibers for information transmission. Shaft mines with an annual output of 3 million tons will employ 350 persons.

2) Coal extraction robots.

Robots in shaft mines will be used first in excavation faces. A three-armed robotic drilling cart has been developed in Norway for continuous procedural control. In the future, robots can be used for extracting extremely thin coal seams and seams under complex geological conditions. They can be used to lengthen drill rods when drilling holes in very dangerous coal seams. They can disassemble and install comprehensive extraction equipment, inspect equipment stoppages, monitor the underground environment and search for underground fires, carry first-aid equipment and materials, and so on. England, Japan, the U.S., the Soviet Union, Sweden, and other countries now are actively developing robots for mining use.

The English professor (Sifo) envisages the achievement of unattended mining through the use of robots controlled by people at the surface to operate machinery in underground mines. Special research reports point out, however, that certain conditions must exist for using such robots. Existing coal extraction techniques and equipment must be redesigned and equipment and systems must be highly reliable. The robots must be able to adapt to terrible underground environments and make automatic readjustments according to changes in coal seams. Moreover, they should have the functions of self-diagnosis, stoppage elimination and mutual inspection and repair. All mechanical equipment used in underground mines must be able to work in non-ventilated environments and information transmission systems must be absolutely reliable. Such robots would be used for extraction of excellent coal seams that cannot be extracted using conventional methods.

Research reports indicate that development of robots for underground mining will take 15 to 20 years. The excessively high development expenses have slowed research in this area.

3) Underground coal gassification.

The Soviet Union has been experimenting with underground coal gassification for 50 years and now has two experimental gassification stations with an

annual output of 1 billion cubic meters of gas. Tests also are being done in the U.S., West Germany, Belgium, France, Poland and other countries. Experiments in America are using the most advanced technologies including computer simulation, directional drilling, remote metering and remote sensing, oxygen blasting and so on. West Germany and Belgium are carrying out joint experiments on gassification of coal seams 1,000 meters deep and have obtained high thermal value coal gas using oxygen blasting. Overall, however, there have been no major breakthroughs in underground gassification technologies. The key lies in the complex and variable geological conditions that make it very difficult to achieve effective control of the gassification process. Yields and the thermal value of the coal gas are low (less than 800 kilocalories/cubic meter in the Soviet Union) and production is not stable. Experts feel that improvements in gassification technologies could make it possible to compete with underground extraction through gassification by injecting oxygen into deep coal seams surrounded by dense rock to produce high thermal value coal gas.

4) Chemical extraction of coal.

There are many forms of chemical extraction of coal. Those now being studied may be divided into three categories. The first is the solvent extraction method. The U.S. is attempting to use a new technique for hydrogenated liquification of surface coal--the solvent refining method--for underground gassification. The second is the chemical fracturing method, which injects alcohol, liquid nitrogen and other materials into coal seams and causes the coal to break into pieces smaller than 0.5 mm. Air or nitrogen gas is then used to transport it to the surface. Both the U.S. and the Soviet Union are studying this method now. The third is the microbial decomposition method that is now being studied in England and the U.S.

All of these methods are at the laboratory stage and many problems must be solved before they are actually used. Such problems include accurate prediction of the geological conditions of coal seams, high-precision directional drilling, selective pressurized fracturing, automatic monitoring and control of the fracturing or dissolution process, methods of moving the product to the surface, control of extraction areas, supplies of huge amounts of chemical solvents, and so on.

5. Social and economic effects of reforms in coal mining technologies.

Coal's re-emergence as the world's primary energy resource and major changes in coal production and utilization technologies will have enormous influences on the economy and society.

1) Coal will replace petroleum as the world's primary energy resource.

As mentioned above, coal will once again become the world's primary energy resource during the early part of the 21st century.

It can be imagined that coal will have an enormous effect on economic development in all nations of the world, on improvement in the people's quality of life, on international trade and on the world political situation that will be somewhat similar to petroleum in today's world. At that time, the three largest coal producers in the world, China, the Soviet Union and the U.S., will become the primary sources of energy resource supplies and they will provide a strong motive force for economic and social development in the Pacific Rim region (coal production will be concentrated in central Asia in the Soviet Union and in the western part of the U.S.).

2) Changes in regional economic structures.

The easily-extractable coal resources in the traditional coal producing nations of the world are gradually shrinking and coal development is migrating to frontier regions. Technical progress is stimulating this migration. Future increases in coal output in the Soviet Union apparently must rely entirely on large open-pit mines in Siberia. The proportion of total national annual coal output produced west of the Mississippi River in the U.S. jumped from 5 percent in 1970 to 32 percent in 1982. The focus of coal development in China is also moving westward.

The migration of coal development to frontier region will bring about major changes in the economic and social structure of these regions and will gradually transform the distribution of energy-consuming industries.

3) Changes in labor structures in the coal industry.

The application of new technologies, especially microcomputer technologies, will inevitable cause changes in labor structures. Modern coal mines have become industries that need large numbers of scientific and technical personnel and skilled technical workers. Underground technical workers in the coal mines of developed nations must have a polytechnic educational level. The proportion of the total labor force in the Soviet Union's coal industry that are scientific and technical personnel with specialized education at the college or secondary school level has grown from 6.6 percent in 1960 to more than 20 percent now. There are a total of more than 500,000 scientific and technical personnel, 100,000 of them workers, indicating a new layer of worker intellectuals. It is predicted that scientific and technical personnel will account for more than 50 percent of the total labor force by the year 2000.

4) Changes in management patterns and production organization.

Coal mines will change from single coal extraction enterprises to comprehensively integrated enterprises. An integrated body of coal-electricity-chemicals will become the primary management form and the coal industry will become an open industry. An integrated body of coal-electricity-chemicals in the future involves a closed production cycle that extracts coal and converts it into secondary energy resources and chemical products. Processing and recovery of useful products to the maximum degree from coal and the

and the application of "no-waste" technologies will greatly reduce the effects of the environment.

The (Kansike-Aqinsike) integrated natural resource body has an ideal prospective annual output of 1 billion tons of coal (in 2020). Five groups of 6.4 million KW power stations and 20 coal liquification plants with an annual capacity of 3 million tons synthetic gasoline will be constructed. If the production efficiency of open-pit mines is 2,000 tons/person/month, then 60,000 people will be needed to extract the coal. Total employment in the integrated body will exceed 500,000 persons.

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COAL

IMPACT OF NEW TECHNOLOGICAL REVOLUTION ON CHINA'S COAL INDUSTRY (PART TWO)

Beijing SHIJIE MEITAN JISHU [WORLD COAL TECHNOLOGY] in Chinese No 2, Feb 85 pp 3-6

[Text] II. The Challenges and Opportunities Faced By China's Coal Industry

1. Coal occupies an especially important position in China's national economy.

China is among the few nations in the world whose primary energy resource is coal. Primary energy output in China was 713 tons of standard coal in 1983, 71.6 percent of the total being coal, 21.3 percent petroleum, 2.3 percent natural gas and 4.4 percent hydroelectric power.

Coal occupies an extremely important position in China's economy. Coal supplied 75 percent of the nation's industrial fuels and motive power in 1980, as well as 80 percent of railway tractive power, 65 percent of industrial raw materials and 85 percent of urban and civilian fuels.

The resource conditions of each of China's energy resources and the economic, technical and social conditions of development and utilization indicate that, barring unforeseen technological changes, coal will remain China's primary energy resource for the next 30 to 50 years. Total supplies of primary energy resources in China will reach 1.2 billion tons of standard coal by the year 2000. About 70 percent of new additions to energy resource supplies will come from coal. It will be hard for other energy resources to make up the difference if coal supplies are insufficient. Inadequate energy resource supplies are a primary factor restricting economic development in China at the present time. It can be said that the pace of economic development in China is to a great extent determined by development of the coal industry. The coal industry occupies an especially important position in the national economy.

First, in terms of the industrial sector, the adoption of policies to reduce oil burning in boilers and kilns will result in an increase in the proportion of electrical power from coal-fired electrical power stations that burn coal and coking coal in overall energy consumption in the industrial sector. Most important is that electric power resources will rely increasingly on coal. Coal accounted for 60 percent of the

structure of electric power resources in 1980 and will grow to more than 70 percent by the year 2000. Coal use for power generation as a proportion of total coal consumption will increase from the 20 percent figure in 1980 to more than 35 percent by the year 2000.

Second, the rural areas of China are an enormous market for coal. The amount of coal consumed directly for rural production (including industrial and sideline production) and for life exceeded 80 million tons in 1980 and will more than triple by the year 2000. Increased coal use in rural areas is not only an important guarantee for developing industrial and agricultural production in rural areas but also is very important for alleviating excessive consumption of firewood and crop stalks and reversing vicious ecological cycles.

Third, China's chemical industry will continue to be based on coal. Two-thirds of the raw materials used in China's chemical industry come from coal at the present time. The main chemical industry products that use coal as the original raw material include nitrogenous fertilizer, farm chemicals, synthetic resins, plastics, synthetic fibers, dyes and coloring agents, medicines and so on. In terms of value of output, nearly 80 percent of the chemical industry products will serve agricultural and light industry. It can be seen that coal, which serves as a primary raw material for the chemical industry, plays a major role in developing the economy, providing all the people of our country with food, clothing and household goods and improving standards of living.

2. The challenge of the new technological revolution for China's coal industry.

China's coal industry has achieved major results and raw coal output has grown rapidly. China leapt to second place in the world in 1984. This development also involves many problems, however. For a period of many years as China's primary energy resource, the coal industry has continually striven to increase output, but the burden is excessive and supplies of coal still cannot meet demand. Coal prices are too low and most mines operate at a loss. Pressure for output, capital difficulties and other factors have caused a loss of proportion within the coal industry and production technologies are backward. Although there have been obvious improvements following major reform efforts in recent years, there are too many loans for mine safety technical measures and for life and educational construction in mine regions. Much work remains to be completed. A long period of effort is required to change the situation of production technologies. Investment in capital construction still is inadequate despite increases and the scale of construction is inadequate. This has become a prominent contradiction for doubling coal output [by 2000]. There is a major shortage of investments used to guarantee output and it is difficult to guarantee the capital needed for technical progress.

People abroad call mining and other traditional industries waning industries, while newly emerging technology-intensive industries are called rising industries. Some people feel that traditional industries are declining and disappearing. This is erroneous. Compared with traditional industries, however, the newly emerging technology-intensive industries have such advantages as high results and good working conditions. Their appearance confirms the serious challenge faced by traditional industries. This is especially true of the coal industry. The thorough development of the four modernizations and a policy of opening up to the outside will lead to gradual development of the new technological revolution in China and the emerging technology-intensive industries will have an obvious magical charm for everyone. The coal industry, since it has not attracted such attention, obviously faces an especially severe challenge.

- 1) The technological differential from the coal industry in the developed nations and other industrial departments within China may expand.

An examination of the level of technical equipment and the degree of mechanization in unified distribution mines shows that technical levels in China's coal industry are roughly equivalent to those found during the late 1950's and early 1960's in the developed nations. Coal machinery manufacturing plants currently produce 300 products, 70 percent of them at a 50's and 60's level. The degree of mechanization of coal extraction in unified distribution mines is the same as levels found in West Germany and England in 1960, while labor productivity is equivalent to the level found at the beginning of the century in England. Labor productivity in China's coal mines is the lowest of all the primary coal-producing nations of the world.

The coal industry in China also is backward compared with other industrial departments within the country.

Scientific research work on coal in China is weak and receives little funding. Independent development abilities are poor and development and manufacture periods are long. Few achievements become forces of production. Most coal mines operate at a loss, have a low ability to accept new technologies and also lack effective policies for encouraging enterprises to adopt new technologies. If we do not implement major reforms and attempt to keep up with the crashing waves of the new world technological revolution, there could be an expansion of the technological differential between the coal industry in China and abroad, as well as between the coal industry and other industrial departments in China.

- 2) Shortage of qualified personnel.

The intense economic, scientific and technological competition in today's world is actually intellectual competition that gives qualified personnel resources a key position.

The educational level of employees in China's coal industry is the lowest of all the industrial departments in China. In 1980, only 4.6 percent of all employees in state-run administrative units at the county level and

above were college or polytechnical school graduates and only 10.4 percent were high school graduates. Some 70 percent had no more than a middle school education and 15 percent were illiterate or semi-illiterate. Engineering technical personnel accounted for only 1.9 percent of all employees.

Working and living conditions are very difficult in mining regions. Moreover, the wages and welfare considerations of engineering technical personnel are not up to those in other industries. This not only makes it very difficult to attract college students and distribute graduates but also causes many personnel on the job to be unwilling to stay, and large numbers are leaving. There is an extreme shortage of mature technical workers in coal mines, especially workers in underground extraction.

3) Resource and labor power advantages may be lost.

During this century, China will increase coal exports in order to maintain a trade balance, to use goods to compensate for foreign capital, and other reasons. Like other commodities, coal faces intense competition on international markets. China is profiting from exporting coal at the present time. Apart from price distortions, China has certain advantages that are due primarily to the high quality of our coal resources and cheap labor, making coal production costs low.

Of course, it must be noted that there is a serious danger of losing our resource and manpower advantages if there is a further expansion of the technological differentials between coal mines in China and abroad. Productivity in large open-pit mines in the U.S. is several tens of times or even more than a hundred times higher than in open-pit mines in China and the cost of a ton of coal is now lower than the average costs in China's unified distribution mines.

In China, small collective coal mines have the basic conditions for development and also provide high-quality coal resources and cheap labor power in rural areas. The amount of shallow resources suitable for extraction in small mines in the eastern part of China is shrinking rapidly. The increased wealth in rural areas and the policy of only having a single child mean that coal mines will be facing an increasingly serious challenge in recruiting workers if they do not make major improvements in labor and safety conditions. This is especially true for small coal pits.

2. An opportunity to speed up development of the coal industry.

The new technological revolution also provides an opportunity for speeding up development of coal mines in China. Reliance on technical progress may permit the coal industry in China to complete several major changes in a short period of time that already have been completed in the developed nations, particularly the transition from manual operation to mechanization. There will be a transition from an inability to control terrible accidents and occupational diseases to an ability for basic control. There will be a

transition from single production of raw coal to the development of multiple product types, gassification and liquification. There will be a transition from simple coal extraction to comprehensive administration, and coal transport will adopt many forms and high efficiency equipment. The newly-opened route for development of the coal industry has the advantages of rapid increases in output with relative stability. It can develop in a healthy and safe manner with good economic results. Modernization of the coal industry will be achieved on the basis of the achievements of the new technological revolution.

1) It is possible to jump over certain traditional stages of development.

Although technical levels in China's coal industry are very backward relative to the developed nations, there is still a substantial foundation and a certain technical strength. Some technical levels have approached or attained advanced world technical levels. Examples include drilling technologies, shaft surface blasting, anchor rod support technologies, hydraulic coal extraction technologies, "three below" coal extraction technologies (below bodies of water, buildings and railroads), fluidized-bed technologies and so on. Comprehensive extraction technologies now have appeared and are developing fairly quickly. It is entirely possible that China will be able to jump over certain traditional development stages in the developed nations and adopt advanced technologies suited to our national conditions if our policies and measures are appropriate. An example is geological exploration of coal fields. A satellite launched by China has changed traditional survey models and we have completed 1:50,000 geological surveys of all the coal fields in China. Joint development between China and other nations in the area of open-pit extraction and a focus on designing modernized large-scale open-pit mines, equipment manufacture and production management technologies. In the area of shaft extraction, we can adopt advanced microcomputers and microprocessors to outfit newly-constructed large-scale shaft mines and key reconstruction of coal mines and achieve underground environmental monitoring, and remote sensing, remote control and automation of large-scale fixed equipment and production management.

2) We can import advanced technologies from abroad.

Importation of technology has just begun in China's coal industry and there is great potential. We now are importing or planning to import several items, most of them at a 1970's level in foreign countries.

In the future, we can adopt multiple patterns and multiple channels to expand the scale of technology imports. This is a path to faster technical progress in China's coal industry.

3) It is possible to use advanced technologies to speed up administrative reforms.

The establishment of a departmental management information system based on microcomputers and cooperation between China and other countries to import

modern management ideas and scientific management methods will promote managerial reforms in the coal industry. This is of no less significance than innovation in production technologies because most of the problems in coal mines are 70 percent management and 30 percent technology.

III. Face the Future, Study Countermeasures

The question of the policies that China's coal industry should adopt to meet the challenge of the new world technological revolution is a major strategic question that concerns the future of the coal industry. I will provide some immature viewpoints here for reference.

1. Countermeasures should be based on new development strategies.

Development of the coal industry in China has taken a path of extensive management for a long period. The only concern was increased output. Quality and results were ignored. The result has been not only tremendous waste but also a restriction of the development of the coal industry itself. There is a way out for this developmental pattern that has long been obsolete. A new path for development of the coal industry must be adopted that has a prerequisite of focusing on improved economic results and higher quality and efficiency. We must advance firmly along the path for developing the coal industry in China that was formulated by the ministry leadership to achieve five major changes and four requirements.

Another question related to development strategies is that on the one hand we must use our resource and labor power advantages to produce more with fewer inputs and strengthen development in mining region in eastern China, actively develop small coal pits, and produce as much coal as possible under conditions of investment shortages to satisfy the urgent needs of the national economy. On the other hand, we must overcome the disadvantage of backward production technologies in China's coal industry and establish a good technical foundation, strengthen scientific research and education, build a group of open-pit and shaft mines using advanced technologies, and use advanced technologies to develop large new base areas with good resource conditions. This is a short-term need. Even more important is making good preparations for medium and long-term development.

2. Actively carry out reforms well.

Draft the necessary policies such as rational coal pricing policies, policies to encourage enterprises to adopt new technologies, policies to bring in qualified people and so on to make coal enterprises more dynamic and wealthier, transform the situation in the coal industry, and enable coal mines to have a substantial attractive force. Besides raising coal mine employee wages, we should improve the environment and middle and elementary school education in mining regions, establish a nationally unified system of holidays and uniforms for coal mine workers, bestow honorary titles on superior coal mine employees and encourage everyone to devote themselves to the arduous cause of coal.

3. Strengthen technical development and importation.

Scientific research units should strengthen construction of test facilities. Specialized research institutes gradually should establish and perfect experimental base areas to form a driving force in their own technological specialization. We must make great efforts to extend scientific research achievements and broadly develop technical innovation activities.

We should adopt multilayer technologies suited to different conditions. This means active adoption of advanced foreign technologies from the 1970's and early 1980's like comprehensive extraction, computer monitoring and control, large scale open-pit mine technologies and so on, and we also should carry work to develop effective technologies suited to small coal mines in China. We should actively develop long wall comprehensive extraction and select coal mines with suitable condition for testing and using continuous coal extraction machinery for coal extraction according to the room and pillar method. This is the primary method of coal extraction in the U.S. and Australia and the results are very good.

Under conditions of capital difficulties and shortages of qualified personnel, importation of foreign technology should be given a primary place in coal technology development.

Importation work in China's coal industry primarily involves importation of equipment. The steps taken in technology importation have been small and few methods are employed. There has been a bit of progress recently, but the scale of technology importing is extremely backward in comparison to other departments within China. Now is the time when we should move from importing large amounts of equipment to importing technologies. The technologies we import should be put into use for our purposes quickly and we should strive to manufacture them within China as quickly as possible. There should be reforms in organization and management, science and technology policies, scientific research systems, testing measures, personnel training, information and consulting and other areas in importation work.

Moreover, we should strive to absorb advanced technologies from other industries within China. Many industries in China, especially the national defense industry, are more advanced than us in many areas of technology. We should adopt joint tackling of key problems and other patterns to transplant their advanced technologies.

4. Rational utilization and training of qualified personnel.

We first of all should make personnel utilization and training the focus of reform work, eliminate all obstructions and further implement the policy on intellectuals. We must create better working and living conditions for scientific and technical personnel. Wages paid to scientific and technical personnel in the coal system should be at least one grade higher than in other industrial departments. Second, we must establish a selection, testing and rotational training system for scientific and technical personnel and cadres. Third, we should strive to improve

teaching conditions in coal colleges and vocational schools, adopt many different measures to expand training capabilities and improve the quality of education. We must pay special attention to polytechnical education. The coal system currently has a 1:1 ratio between college and polytechnical (including province run schools) students in school. This indicates a serious loss of proportion since the figure should be 1:5. Students in coal colleges and schools should receive fairly high assistantships and scholarships should be established for the most talented people.

5. Adopt economic policies to promote technical progress.

Coal prices that are too low and equipment that is too expensive are serious obstructions to technological progress in the coal industry. An increase in coal prices is essential at the present time, as is a substantial rise in the wages of coal workers. This is an effective factor for extending new technologies. At the same time, equipment prices should be lowered and there should be technical transformations in coal machinery manufacturing plants. We should organize specialized cooperation, reform designs and techniques, and strive to lower costs and improve quality. It is estimated that the selling price of domestically-produced equipment can be reduced to one-third that of identical imported equipment. The coal industry now is developing many types of reforms centered on contractual responsibility systems. These reforms undoubtedly will promote technological progress as they become more thorough.

Table 2. Comparison of Primary Indices in the Coal Industry in China and Abroad, 1982

Item/Country	China	U.S.	Soviet Union	Poland	W. Germany	England	Japan
Coal output, million tons	666.3	756.1	718.0	227.0	216.3	124.7	17.6
Proportion of output from open-pit mines (%)	2.9	60.1	40.0	16.4	57.0	12.6	7.5
Degree of mechanization of coal extraction(%)	40.0	99.0	96.0	96.2	99.7	99.0	78.1
Degree of comprehensive extraction(%)	19.4	74.0	69.0	83.8	98.8	97.0	69.5
Number of employees in the coal industry, (10,000 persons)	550.0	22.6	231.0	58.0	20.6	27.0	2.7
Average efficiency in shaft mines (tons/worker)	0.87	9.98	2.23	3.73	3.39	2.41	3.23
Accidental death rate, (persons/million tons)	-	0.16	0.96	0.55	0.47	0.36	1.36

Notes:

1. Output and efficiency in China and the Soviet Union calculated according to raw coal. Other countries calculated according to commodity coal. The ratio of commodity coal to raw coal is 86 percent in the U.S., 81 percent in Poland, 54 percent in West Germany, 82 percent in England and 70 percent Japan.

2. The personnel used for calculation of efficiency include only personnel directly related to raw coal production, which is within one-third of total personnel. The other countries basically include all personnel.

3. Degree of mechanization in coal extraction in China and efficiency calculated from unified distribution mines.

4. The total number of employees in China includes about 800,000 workers in small-scale collective mines.

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COAL

MEASURES TO CONVERT FROM OIL TO COAL SHOWING RESULTS

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 6, 25 Dec 84 pp 1-3

[Article by Li Renjun [2621 0086 0193], State Planning Commission:
"Creating a New Situation in Using Coal Instead of Oil"]

[Text] Based on the goal set by the State Council to reduce oil consumption to 20 million tons by 1990, we have assigned tasks and formulated measures to reduce the oil consumption in the electric power and the petrochemical system. The success of this effort will have a very positive effect on the energy consumption structure and the rational use of energy resources in China.

I. Reduction in Oil Consumption in the Last Few Years

Based on the structure of China's energy resources, the State Council set a policy to reduce oil consumption and to use coal instead of oil; the policy is entirely correct. At the peak of oil consumption, China consumed 40 million tons of oil in 1 year, more than one-half of the national petroleum consumption. Since 1970, the cumulative oil consumption is almost 400 million tons, including 110 million tons of crude oil and 10 million tons of kerosene. In comparison with burning coal, this represents a loss of 40 billion U.S. dollars, an enormous waste. In order to turn the situation around, we have curtailed the amount of oil burned since 1978 and have obtained good results in the past several years. Compared to 1979, 1984 burned 7.95 million tons less oil, but part of the oil saved has been burned by other units. Because of this, the State Council established a special agency in 1981 to manage the oil saved, use the oil for export and for domestic reprocessing and to make use of the export oil price difference to accumulate capital for the state for the purpose of developing the energy transportation industries. This practice has achieved great economic benefits. From 1981-1984, 15 million tons of oil were accumulated at an expected profit of 6.4 billion yuan, creating 1.5 billion U.S. dollars in foreign exchange. Using coal instead of oil has created great wealth for the State. This is practically a windfall; because, without switching from burning oil to burning coal, everybody would have been perfectly happy with burning oil and there would not have been this sum of money for energy and transportation development. Very few of the economic measures we are pursuing now have such attractive economic benefits. The price of 5 or 6

tons of coal on the international market is less than that of 1 ton of oil. In addition, it is hard to export coal. So why should we burn our oil? We must overcome all resistance and difficulties and adhere to the policy of switching from oil burning to coal burning.

The initial achievements of reducing oil consumption are attributed to the hard work of the various departments and regions. Since 1979 a total of 1,700 oil burning boilers (9,800 steam/tons) have been modified and 1,400 boilers (16,000 steam/tons) have been renewed. Liaoning province is a big oil consumer, the Provincial Committee and the provincial government made a gallant effort. Jiangsu, Shanghai and Tianjin paid attention to details and also obtained good results. In the central government, the Ministry of Water Resources and Electric Power implemented a contract system and has exceeded the reduction quota year after year. In the Sixth Five-Year Plan period, 5.8 million tons of oil will be saved, accounting for 70 percent of the national total. The Ministry of Metallurgy also did a good job. They have modified a total of 163 oil burning boilers (3,300 steam/tons) from 1978-1984. The oil burning blast furnaces have all been converted to burning coal. Up to 1984 the Ministry of Metallurgy has reduced oil burning by 680,000 tons, a commendable achievement. Since there are a number of advantages for the enterprises to burn oil, the resistance and the degree of difficulty are both great. We must keep the overall advantage in mind and do what is right for the country no matter how difficult it is. The future work is still formidable and we must consolidate our experience and continue our effort until we accomplish this honorable mission.

The progress made in the reduction of oil burning has already played a major role in the development of energy resources. China now faces a shortage in energy supply and efforts from various quarters are needed to improve the situation. Switching from burning oil to burning coal is an important part in the rational use of energy and in the improvement of the energy consumption structure. The experience in the Sixth Five-Year Plan showed that, unlike some have expected, the switch from oil to coal did not aggravate the shortage of energy supply; on the contrary, it benefited the energy consumption cycle in the following ways: 1) In the area of power plant construction, 5.66 million watts of coal-fired power plants are under construction, using the special fund from the oil to coal switch in the Sixth Five-Year Plan. 1.57 million watts of generators are expected to come on line, replacing 1.1 million watts of oil-burning generators. The replaced or to-be-replaced generators will be modified to burn coal. The modification of the test point generators will be very significant in alleviating the shortage of electric power. Credit should be given to local units for this part of the electric power and the coal slag of the power plants should be utilized to produce by-products such as cement additives or used as sand. The Ministry of Petroleum is also a large oil consumer. At Shengli oil fields, the Zhanhua power plant uses 300,000 tons of oil and there are 400 more oil-burning boilers consuming 200,000 tons of oil. They should also switch to coal; 2) In the area of coal development, the special fund helped to construct 24.95 million tons of uniformly allocated mines with a total investment of 3.1 billion yuan. In the meantime, the "economic coal" policy helped the local mining development. In the Sixth Five-Year Plan, a total of 75 million

tons of economic coal were purchased at 27 yuan per ton, out of which 20 yuan was used for coal mine construction and provided 1.5 billion yuan of capital. In Shanxi Province alone, 30 million tons of coal mines are under construction. The two items above amount to 60 million tons, equivalent to 30 percent of the 1984 construction investment in China. In the last 2 years some local areas complained that they did not get all the coal they needed to replace oil and the opinion seemed to be that the state only asked them to cut back on oil burning but did not provide them with enough coal. The situation just described shows that it was a misunderstanding. Naturally some other subjective circumstances also contributed to that situation. First, the allocation of the oil-replacing coal and the state uniform allocation coal are handled separately, but in practice, they all disappeared into the big pot. This problem has largely been resolved by a receipt system started this year. Second, there was not enough transportation capacity and in some areas the nonproject coal bumped the project coal and state-allocated coal transportation was not accomplished. Starting this year the transportation of the oil-replacement coal will be a separate category and the situation will be very different. 3) In the area of transportation construction, the coal-for-oil special fund invested a total of 1.96 billion yuan to alleviate the shortage of transportation. Jointly funded projects with the State include 9 railroads, 3 harbors and the major overhaul of the canal. It not only met the transportation needs of the oil-replacement coal but also improved the coal hauling capacity.

This problem must be solved with the long-term, fundamental policy in mind. Switching from oil to coal is a long term effort. In today's coal shortage situation, the supply of coal cannot be put on a solid basis even without the switch. If we go ahead with the switch, the problems may be resolved in the future. Without the switch, the future difficulties will be greater. We must understand the reason behind the action. Once we have thought this through, the difficulties at hand will be easier to overcome.

II. Strive for Comprehensive Oil Reduction

The State Council has decided to reduce oil consumption in 1990 by 20 million tons. After the Sixth Five-Year Plan projects are completed, the Seventh Five-Year Plan calls for 10.1 million tons of oil reduction (not including that of the Ministry of Petroleum Industry). In 1985 industrial boilers are expected to burn 2 million tons of oil and industrial kilns are expected to burn another 7.8 million tons, a total of 9.8 million tons. In the Seventh Five-Year Plan, the oil for the boilers and kilns will be cut back by 1.1 million tons. Anticipating the difficulties that will be encountered in some projects, the oil reduction plan will include some extra projects as a cushion. The general requirements are: oil-burning industrial boilers should be converted to burn coal; if the individual units have justifiable difficulties, the conversion may be postponed until future plant expansion or regional heat supply. It must be made clear to industries that requested to keep their oil supply that the temporary approval should not be construed as official consent for not switching over to coal and does not mean that there will be no conversion in the future. If the industrial boiler and kiln cannot be converted to coal burning, some oil should still be replaced

by linking them to the development of urban coal gas and natural gas supply.

The change-over undoubtedly will cause some hardship and oil production may increase in the future, so why don't we slow down the pace of the conversion? We believe that we must persist in the oil reduction effort for at least the following three reasons:

First, reducing the amount of oil burned is an important method in improving China's economic efficiency. Based on the current international oil price, the effort will accumulate 30 billion yuan of capital for the state in 10 years. If the entire amount is exported, it would create 10 billion U.S. dollars in foreign exchange. If the mission can be accomplished in 10 years, then 20 billion yuan of profit can be turned over to the State in the Eighth Five-Year Plan. Although the economy is doing very well in China, we do have some financial difficulties. Several billion yuan from oil consumption reduction per year is a very large sum of money for the State and a major contribution to the construction of the national economy.

Second, it can better serve the demand on oil by the national economy. China has a shortage of primary energy resources; but in some sense, the shortage of secondary energy resources is even more acute. Today, we all feel the shortage of electric power and petroleum products. Compared to coal, the production of oil and the resource conditions of oil are much more scarce. This is true not only in China but all over the world and this is one of the major reasons for the large difference between oil and coal on the international market. This is why we want to substitute the high-priced oil with the low-priced coal and believe that it is the most practical and effective way to ease the demand on petroleum products in the present and future economic development. The Premier stated a policy for oil usage in one of his speeches last year: the oil should be conserved wherever possible, except serving as raw material for the petrochemical industry and supplying internal combustion engines that must burn oil.

The development of power tools and the petrochemical industry place additional demands on the switch over. In the last few years the increase in oil-burning power machinery in China was only 30 million horsepower, but the increase in 1983 was 48 million horsepower. From 1978-1982, the average annual increase in agricultural power machinery was 15 million horsepower, but the increase in 1983 was 20 million horsepower. With future developments in agriculture, industry, and subsidiary occupations in the rural area, the demand on power machinery can expect large-scale increases. Moreover, the highway system in China is not yet developed and accounts for a low percentage of the total transportation volume. In India only 4 percent of the hauling over distances less than 100 km is done by the railroads whereas in China it is as high as 28 percent. The automotive industry in China will undoubtedly have more development. In the development of the petrochemical industry, the four ethylene units imported in 1978 will be put into production in the Seventh Five-Year Plan. All these will present more urgent demands on petroleum products.

Incidentally, the World Bank recently made a forecast for China's economic

development by 2000 and raised several energy issues they deemed most sensitive. One of them is the demand and supply of oil and the use of coal in place of oil. They believe that the key is the Chinese government's policy and attitude toward the coal-oil switch. As can be seen, the success of oil-to-coal conversion is closely tied to the development of the national economy.

Third, petroleum is an important export product of China. Today China exports more than 20 million tons of crude and refined petroleum products per year and oil is a major source of the foreign exchange. The conversion from oil to coal is therefore more than just a technical policy issue but has a multitude of significance. Treating it as a national policy, we must reiterate and repeatedly emphasize this policy so that it is widely understood and thoroughly implemented. The philosophy has been explained before but not everyone involved has understood it; it should therefore be repeatedly publicized. We should also evaluate our understanding and attitude in the past and our work in the last few years so that we may consolidate our experience and step up our effort to conserve oil by using coal.

III. Adhere to Urban Reform Spirit, Establish an Economic Responsibility System for Oil-to-Coal Conversion

Today, the reform movement is bound to move forward. The agricultural reform is developing at a fast pace and the industrial reform has also produced convincing results. To change the habit of eating out of the big pot, we must establish an economic responsibility system. We have already done so for the oil-to-coal conversion effort in the electric power and the petrochemical systems and laid down a sound foundation for future work. We should do the same for industrial boilers and kilns. Judging from the results of the oil consumption reduction agreement reached by the Ministry of Water Resources and Electric Power, the economic responsibility system makes all the difference. The major contents of the responsibility are the "three contracts, two premiums, and one penalty."

The three contracts are the investment contract, the work progress contract, and the oil reduction contract. The investment contract is a subsidy of 400-500 yuan for every ton of oil saved. The work progress contract allows 1.5 years for 10 ton/hour boilers, 2 years for 10-35 ton/hour boilers, and 2.5 years for 35 ton/hour and above, measured from the date the project is approved. (All of above represent the total steam/tons).

The two premiums are: first, a unit can keep the amount of fund saved in the total contract investment, and second, additional premium funds will be allocated for each ton of oil saved. Half of the premium funds will be used as production development funds and bonuses for the enterprise and the other half will be used as benefits and award money for the design, construction, and oil reduction units.

The one penalty is that, if a project is not finished on schedule, the oil reduction will still be made according to the original plan and the enterprise must absorb the loss and cannot place the burden on the consumers by raising prices.

The central theme of the responsibility system is to mobilize the initiative-ness of the enterprises and to encourage saving oil. All new projects should be implemented according to this scheme and projects already under way may finish their final investment contract under this system. Why do we reward the enterprises that are slow in saving oil? First, it is the new policy of the Central Committee; and second, it is more difficult for these enterprises to cut back their oil consumption.

To establish an economic responsibility system and to accomplish the oil reduction plans for 1985 and for the Seventh Five-Year Plan, we must act fast and work hard to finish the assigned tasks.

9698

CSO: 4013/75

COAL

BRIEFS

NEW HEBEI COAL MINE--Shijiazhuang, 10 Mar (XINHUA)--A coal mine with an annual capacity of 1.2 million tons went into operation in the Kailuan Coalfield, Hebei Province, earlier this month. The Linnancang Mine was built 2 months ahead of schedule, originally set for 1 May 1985. The North China Coalfield, with an estimated reserve of 8.7 billion tons, is China's second biggest coal producer. [Text] [Beijing XINHUA in English 0230 GMT 10 Mar 85 OW]

LIAONING LOCAL COLLIERY GROWTH--In 1984, Liaoning Province made marked progress in developing local collieries. The number of collieries run by collectives and individuals reached more than 1,000 mines, turning out 4.51 million tons of coal. Collieries in the province whose products are not covered by the state unified plan turned out 7.9 million tons of raw coal in the year, topping the level scored since the founding of the PRC. [Summary] [Shenyang Liaoning Provincial Service in Mandarin 1030 GMT 7 Mar 85 SK]

CSO: 4013/111

OIL AND GAS

MORE ONSHORE OIL AND GAS RESERVES VERIFIED

OW121159 Beijing XINHUA in English 1138 GMT 12 Apr 85

[Text] Beijing, 12 Apr (XINHUA)--China verified an additional 1 billion tons of onshore oil reserves in 1984.

This was disclosed by Tang Ke, minister of the petroleum industry, at an international symposium on geophysical exploration which opened here today.

Among the discoveries were five big new fields with estimated reserves of more than 50 million tons and 24 medium-sized fields in the 10- to 50-million-ton range.

The newly found deposits are scattered in newly explored zones in the existing fields such as Shengli, Liaohe, Daqing, and Dagang.

Important discoveries were made in the Junggar, Qaidam, and Shaanxi-Gansu-Ningxia basins of northwest China.

Last year also saw a big increase in newly confirmed natural gas reserves.

CSO: 4010/128

OIL AND GAS

NEW WELL GUSHES OIL IN SOUTH CHINA SEA

OW120732 Beijing XINHUA in English 0721 GMT 12 Apr 85

["New Well Gushes Oil in South China Sea"--XINHUA headline]

[Text] Beijing, 12 Apr (XINHUA)--A workable well has been found in the Pearl River Delta, according to the China National Offshore Oil Corporation.

Tests show 6,840 barrels of crude oil a day at a depth of more than 1,920 meters.

This is the fifth strike announced since the operations started last year.

Another exploratory well has been sunk at a site some 29 kilometers northwest of the first one.

Phillips Petroleum International Corp Asia, a subsidiary of Phillips Petroleum Corp of the United States, is undertaking these operations.

The contract for exploration and development in this area of the South China Sea went into effect in January 1984. Phillips and Pecten Orient, a subsidiary of the Pecten Company of the United States, each cover 50 percent of the costs of exploration.

CSO: 4010/128

OIL AND GAS

DAQING FIELDS PRODUCE 52.3 MILLION TONS IN 1984

HK220639 Beijing CHINA DAILY in English 22 Mar 85 p 2

[Article by Ma Zhiping]

[Text] The Daqing Oil Field in northeast Heilongjiang Province has repaid the state's investment 20-fold and staked its claim as one of China's major petrochemical centres.

Since it first opened in 1960, the field has cumulatively produce 683 million tons of oil and turned over 64 billion yuan in profits to the state, according to a recent report from the Daqing Oil Administration Bureau.

By the end of 1983, there were 2,065 square kilometers of land in oil production, and a geological survey estimates proven oil reserves at about 3.5 billion tons.

Daqing to date has tapped seven oil fields, including Saretu, Lamadian, Xingshugang, and Putaohua.

Over the past 24 years, the technicians have made 11,150 test drills and 6,323 resulted in commercial production. About 17,000 kilometers of pipeline have been laid to facilitate transportation of the resources.

In 1976, the field began full-scale production with an annual output of 50 million tons. Last year, the yield increased to 52.3 million tons.

Daqing oil specialists have pioneered new techniques in their quest for "black gold." They have won 334 government awards for science and technological achievement. Their dedication has resulted in high, stable yields.

Oil production has created industrial spin-off in the area. Petroleum refining and petrochemical works began to flourish in the late 1970s. Imported equipment has upgraded Daqing's oil industry and allowed it to provide an increasing flow of raw materials to other industries. The establishment of a 300,000 ton ethylene plant indicates that Daqing is firmly rooted as a production centre for petrochemicals, fuels, fertilizers and synthetic fibres.

CSO: 4010/115-F

OIL AND GAS

LARGE NEW OIL FIELD DISCOVERED AT SHENGLI

Jinan Shandong Provincial Service in Mandarin 2300 GMT 20 Mar 85

[Text] The Shengli Oil Field has discovered a large new oil field with more than 100 million tons of oil deposits in (Gudong) District on the northern bank of the mouth of Huang He River. This is the biggest oil field compared to those newly discovered in the past few years throughout the country.

The newly discovered oil field has the following characteristics:
Its area of oil deposits is large; its pockets of oil are many and thick and are near the earth's surface; and its oil deposits are easy to exploit.

The Shengli Oil Field began to prospect this oil field in March 1984. As of now, it has drilled 13 oil wells that contain their own pockets of oil averaging more than 30 meters deep each. The thickest one reaches 128 meters. In the near future, the new oil field will become an important oil production base in Shengli Oil Field.

CSO: 4013/111

OIL AND GAS

MORE RESERVES UNCOVERED IN JUNGGAR BASIN

Beijing RENMIN RIBAO in Chinese 28 Jan 85 p 1

[Article reprinted from XINJIANG RIBAO: "Amount of Proven Geological Reserves Found by the Xinjiang Petroleum Management Bureau Over the Past 2 Years Is 1.5 Times the Amount for All the Previous 32 Years"]

[Text] Petroleum geology exploration work in the Junggar Basin has reached a pleasing pace following major breakthroughs in 1983. Newly proven geological reserves found by the Xinjiang Petroleum Management Bureau in 1984 were 50 percent higher than in 1983, and the reserves obtained over this 2-year period are 1.5 times the amount found over the previous 32 years, equivalent to an increase from 1 Karamay [oil pool] to 2.5 Karamays.

Proven geological reserves are a prerequisite for development of the petroleum industry. The Xinjiang Petroleum Management Bureau has put forth the goal of quadrupling [proven reserves] by the end of the century, which requires us first of all to find the corresponding geological reserves. Through meticulous planning and theories by the Bureau leadership, those with primary responsibility for managing exploration and engineering and technical personnel decided to divide their efforts into two steps to complete this strategic task and planned to complete 50 percent of the task in the previous 3 years and the next 2 years. The actual speed over the past 2 years has far exceeded plans, however, and 40 percent of the corresponding reserves have already been found.

The Bureau has concentrated on letting engineering and technical personnel "play the leading role" on the exploration stage. They have shouldered the burden and given full play to their intelligence. Along with choosing outstanding intellectuals to take responsibility for leadership work in the Bureau, in plants and offices, and in the offices of Bureau organs, the Bureau also has selected over 300 outstanding intellectuals for first-level positions as chief engineers (chief geologists) and head engineers (head geologists) and has given them technical policymaking authority, production guidance authority and administrative management adjudication authority. They have taken over as masters of the enterprises. Scientific and technical personnel have achieved enormous breakthroughs in research and experimentation on petroleum exploration theories and practice in recent years. The discovery of a large oil and gas accumulation zone in the overthrust fracture zone at the northwestern margin of the Junggar Basin and the breakthrough in research on the lithic systems of

oil-bearing strata in the Karamay-Wuerhe region have opened a new realm for exploration and development of the entire oil field. The implementation of a new development program of a "three-in-one combination" of exploratory drilling, developmental drilling and heavy repair drilling has greatly accelerated the pace of oil exploration.

Adhering to the policy of opening up and importing advanced technical equipment from foreign countries is another important factor in the rapid progress achieved in geological exploration. The equipment in geological exploration departments has been raised to a new level and full digitalization has been achieved in the equipment used in geological surveys.

12539

CSO: 4013/94

OIL AND GAS

MORE U.S., FRENCH SEISMIC TEAMS TO ASSIST IN OIL PROSPECTING

OW220144 Beijing XINHUA in English 0126 GMT 22 Mar 85

[Text] Urumqi, 22 March (XINHUA)--China will employ 15 more U.S. and French seismic prospecting teams with 300 specialists this year to help in its oil endeavor, according to geological authorities here.

The new teams, from four major geophysical prospecting companies, are to work in [the interior], coastal areas along the Bohai Gulf, and other areas.

The focus of the explorations will be areas with complicated geographical conditions, such as deserts and alkaline land. Seven corresponding data processing and analysis centers will also be set up.

The petroleum departments of the Xinjiang Uygur Autonomous Region and Qinghai Province, both in northwest China, have employed eight foreign seismic teams for oil exploration in the Junggar, Qaidam, and Tarim basins.

In the Junggar Basin, three French Seismological teams recently formed the first preliminary picture of the basin's base structures.

They confirmed and discovered 35 local structures, identifying spots favorable for exploration of oil and gas reserves.

In the course of 11 crossings of the Taklamakan desert in the Xinjiang Uygur Autonomous Region, two American seismic teams and one Chinese team completed 4,000 km of seismic exploratory lines, establishing rich data on shallow, medium, and deep strata in relation to oil and gas exploration and development.

Three other American teams reported good results in the Qaidam Basin and at the same time trained Chinese technical and managerial personnel.

CSO: 4010/112

OIL AND GAS

NEW TECHNOLOGY HELPS JIANGHAN FIELDS MAINTAIN FLOW OF CRUDE

Wuhan HUBEI RIBAO in Chinese 7 Jan 85 p 2

[Article: "Jianghan Oil Fields Promote Petroleum Exploration and Development by Scientific Research"]

[Text] The Jianghan Oil Field has maintained a balanced oil recovery record of 1 million tons of crude oil production for nine years in succession. This oil field is inseparable from active development of scientific and technological research and application. In the 5 years from 1979 to 1984, this oil field completed 655 scientific and technological projects, including 421 applied to oil field exploration and recovery with economic benefits of over 55 million yuan.

Due to its geological structure, it is very difficult to find and recover oil in the Jianghan Oil Field. To ensure balanced oil production, the oil field organized scientific and technical personnel to engage vigorously in scientific and technical activity to reform and find new potential in old oil wells. In five years, they received prizes from the Nation, the Ministry of Petroleum Industry, and Hubei Province for inventions, applying new technology, and superior results for 34 scientific and technical projects. In 1983, the Geological Exploration Company accepted the task for three-dimensional seismic explorations and made the exploratory well success rate improve from last year's 27.7 percent to 80 percent, saving more than 15 million yuan in well-drilling costs. In September 1984, the company also used Chinese-manufactured electronic computers to develop new three-dimensional seismic survey technology to process China's first three dimensional display and three dimensional composite box display, filling a gap in China. In 1980, the Oil Field Design Institute introduced advanced Japanese technology and through improving it they developed a high-efficiency furnace that produced 55 kilocalories per hour and had a thermal efficiency of 89 percent, which exceeded that of the Japanese furnace. Later they improved it year by year and in 1984 the thermal efficiency was 91 percent so that the oil field's research on high efficiency furnaces has always been at the advanced domestic levels.

8226
CSO: 4013/98

OIL AND GAS

THE ORIGIN OF THE LONGMEN SHAN OVERTHRUST ZONE AND ITS OIL AND GAS PROSPECTS

Chengdu TIANRANQI GONGYE [NATURAL GAS INDUSTRY] in Chinese Vol 4 No 3,
28 Sep 84 pp 1-8

[Article by Han Keyou [7281 0344 3731] of the Northwest Sichuan Mining District]

[Text] The Longman Shan overthrust fracture zone is located in the transitional zone between the Longmen Shan geosyncline and the Sichuan block at the north-western margin of the Sichuan Basin. It covers an area of about 20,000 square kilometers, bounded on the southwest by the Tianquan fracture, on the northeast by the Guangyuan fracture and on the northwest by the North Sichuan [Chuanbei] fracture. It may be divided into southwest and northeast sections at the fracture running from Anxian to Beichuan. This article mainly discusses the northwest section that extends from Anxian to Guangyuan.

Overthrust fracture zones are a new area of oil and gas exploration in China and abroad at present. Many oil and gas pools associated with overthrust fractures were found in several countries during the 1970's. An example is the 19 oil and gas pools that were discovered in the western United States in an overthrust fracture zone in the Los Angeles Mountains from the discovery of the (Panwei) oil pool in 1975 up to 1982. It is predicted that they contain reserves of 832.7 million tons of crude oil and 310.8 billion cubic feet of natural gas. This raised a high tide of oil and gas exploration in overthrust fracture zones and a large number of oil and gas pools were discovered at the margin of the Appalachian Mountains in the east. The Soviet Union also discovered 45 oil and gas pools associated with overthrust fracture zones in the (A'erbaqian) Mountain depression. China also has paid a great deal of attention to exploration and research work in overthrust fracture zones and has achieved certain results. Oil flows to different degrees have been found all along the fracture zone running from Karamay to Urumqi in Xinjiang. Expanding the range of oil content permitted the discovery of new oil strata. Exploration in the piedmont overthrust fracture zone in the Helanshan Mountains at the western edge of the Ordos Basin led to the discovery of seven small oil pools in the area of Majiatan. Industrial gas flows also were discovered in the upper Paleozoic in the Liujiazhuang and Shenglijing structures.

Exploration for oil and gas began fairly early in the Longmen Shan overthrust fracture zone. The first exploratory well, Jiang No 1, was drilled in the Jiangyou Haitangpu structure in 1945. This served as the focus of exploration after Liberation, and later progress in seismic and exploratory drilling work led to the discovery of the Zhongba and Hewanchang gas pools. Moreover, there

are oil and gas occurrences in seven structures that are prospective exploration regions. I will discuss the oil- and gas-bearing conditions of the Longmen Shan region in five parts.

I. Formation and Development of the Longmen Shan Overthrust Fracture Zone

Like other overthrust fracture zones, the Longmen Shan overthrust fracture zone is located at the zone of contact between a block and a geosyncline. This is a special structural condition in the formation of overthrust fracture zones. Based on comprehensive analysis of gravitational, aeromagnetic, seismic, surface structure and natural seismic data, I feel that the formation of the Longmen Shan overthrust fracture zone is not only related to the Sichuan block and the Longmen Shan geosyncline, but is also closely related to the compressive thrust of the (active) Zoige block and the Motianling uplift toward the southeast. It will discuss its formation in terms of three questions:

1. Structural components and characteristics of adjacent areas.

The southeastern boundary of the Longmen Shan overthrust fracture zone is very near the Sichuan block, while the northwestern boundary adjoins the Longmen Shan geosyncline. The area to the north of the geosyncline is the Zoige block, while the area to the northeast is the Motianling uplift (Figure 1). There are different understandings of these two structural components. They usually are considered to be geosynclines, but several people have studied their structural qualities in recent years. Comrade Zhao YOUNIAN [6392 0645 1628] has suggested that Zoige is a block, while Motianling is an uplift, and he has described the structural characteristics of both.¹ This author agrees with this viewpoint, and will provide additional data on the basis of existing information:

1) Zoige block: Gravitational and aeromagnetic data indicate a rigid basement. It is expressed gravitationally as a positive anomaly centered on Zoige. The gravity line is smooth with very few secondary anomalies. It also appears as a positive anomaly in aeromagnetic data. The surface of the region is formed primarily from the Triassic system. No magmatic rock has been found yet. The structures lie in an arc-shaped distribution around it. The Permian and the lower Triassic become thinner moving toward the center of the block. The lower series of the Permian system is only 19 meters thick at Zhuoni in Songpan, for example, and only 44 meters at Zhuwo. It is felt, however, that the Zoige region originally was a rigid basement block and it is inferred that there the sediments are primarily Paleozoic carbonatite. It did not sweep into the Longmen Shan geosyncline until it became an active block at the end of the late Triassic.

2) Motianling uplift: This appears as a nose-shaped positive anomaly running from northeast to southwest on Bouger gravitational maps and as a positive anomaly belt running from northeast to southwest in aeromagnetic maps, indicating that it is a basement uplift. The sedimentary capping strata have the characteristics of platform facies. The upper Sinian system, the lower Paleozoic and the interior of the Sichuan Basin all have these characteristics. The

author surveyed the Bikou group, which was named by the former Gansu Province Geology Bureau, in a belt running from Qingchuan to Haoxi and discovered the Sinian system and the lower series of the Cambrian in the Qiaozhuang Gorge. According to profile measurements, the Dengying suite of the lower series of the Sinian system is 412.4 meters thick, with botryoidal structures developed in the lower segment. Moreover, there were several types of fossilized algae which were identified as *Siphoniahebeca* and other types by Cao Ruiji [2580 3843 7535] at the Nanjing Paleontology Research Institute. In addition, the Doushantuo group and the lower series of the Sinian system also were found. The lower series of the Cambrian system is 1,000.9 meters thick and breaks off at the bottom. Only 45 meters of black-colored battie were found, with an interbedded 24.6 meter-thick stratum of siliceous dolomite (equivalent to the Xiannutong group in north Sichuan). The top 124 meters are gray-green flint- and quartzite-bearing sandstone (equivalent to the Modaoya group in the Guangyuan belt). The Ordovician system above is missing, forming a deceptive conformity with the highly-metamorphized Silurian system.

The upper Paleozoic and the middle and lower series of the Triassic are a group of platform facies carbonatite sediments that contain a large amount of Yangtze region fossil groups.

The sedimentary capping strata above show that the Motianling region is not a geosyncline, but is instead an Indosinian period uplift. It became part of the Indosinian folding belt only as the Tailing and Longmen Shan geosynclines were folded upward at the end of the Triassic, and the compression to the south-east directly influenced the formation of the overthrust fracture zone.

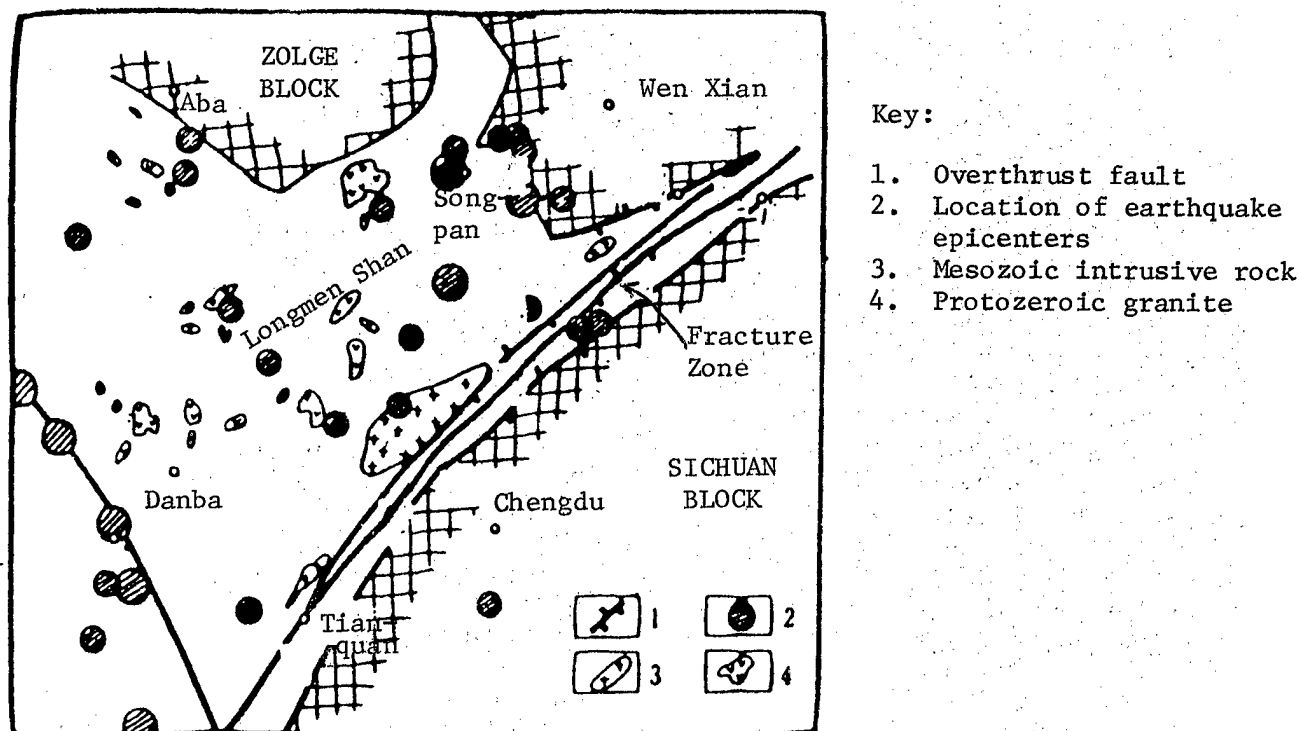


Fig. 1 Relationships of Regional Structures in the Longmen Shan Overthrust Fracture Zone

2. Crustal structure of the overthrust fracture zone

Comprehensive analysis of gravitational, aeromagnetic, seismic, surface structure and stratigraphic data in combination with natural seismic data indicates that there is a fairly unusual crustal structure in the Longmen Shan overthrust fracture zone in that it is found at two different crustal contact zones. The Sichuan block to the southeast is a region of mantle uplift. The mantle, a rigid basement, is 40 to 45 kilometers thick and is composed primarily of humite and salic strata. The Longmen Shan geosyncline is a region of mantle subsidence. The mantle is 60 to 65 kilometers thick and, besides containing humite and salic strata, has above it a very thick stratum of Protozoic marine facies metamorphic rock interbedded with eruptive rock, and is a flexible basement. The overthrust fracture zone is located on the belt of alternation of the two and is a mantle slope. It appears as a northeast-oriented dense gradient zone on Bouguer gravitation maps, the gravitational value dropping by 200 milligals over a distance of 40 kilometers moving from east to west. The slope of the mantle is estimated to be about 10° (Figure 2).

The overthrust fracture was formed on this basis. The collision of the Indosinian Plate with the Eurasian Plate caused the Tethys Sea to fold upward and be compressed to the northeast. This led to decollement between the metamorphic bedrock and the salic strata, which in turn was intensely folded as it met the barrier of the Sichuan block.

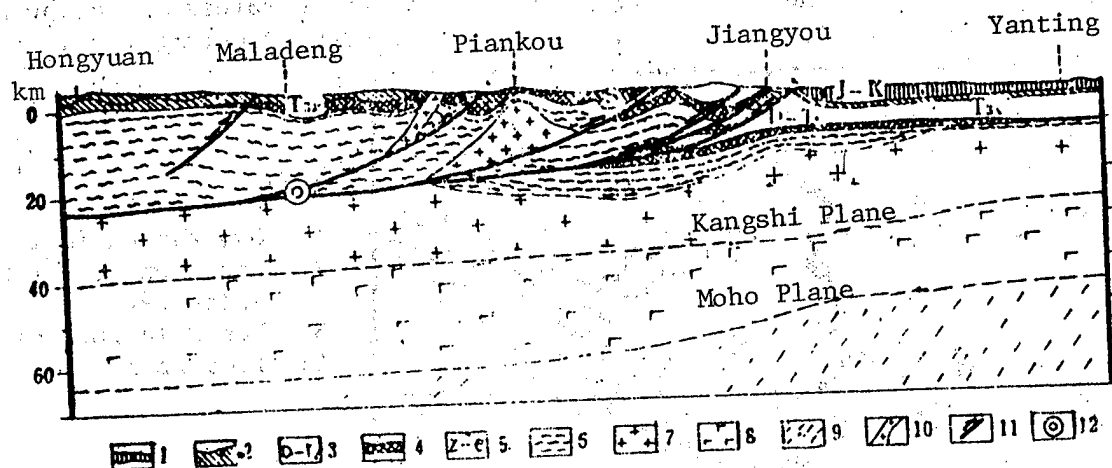


Fig. 2 Model of the North Section of the Longmen Shan Overthrust

Key:

- | | |
|--------------------------------|---------------------------------|
| 1. Jurassic-Cretaceous | 7. Salic stratum |
| 2. Upper Triassic | 8. Humite stratum |
| 3. Permian-Middle Triassic | 9. Upper Mantle |
| 4. Silurian | 10. Intrusive body |
| 5. Sinian-Cambrian | 11. Overthrust fault |
| 6. Pre-Sinian Metamorphic Rock | 12. Earthquake epicenter region |

3. Brief developmental history

If we look again at the formational mechanisms of the Longmen Shan overthrust fracture zone in terms of their development through geological history, we discover that it was an extremely complex process. We can see in Figure 2 that the crustal structures on the two sides of the Longmen Shan overthrust fracture zone are different. The zone went through relative subsidence from the Paleozoic to the end of the Triassic and accumulated shallow-sea marine facies sedimentary strata more than 15,000 meters thick. They had changed to continental facies sediments by the late Triassic, and the enormously thick sediments became a huge material foundation for oil and gas generation. It has the special characteristic of alternating development of violent subsidences and substantial uplifts, mainly undergoing three periods of uplifting and two periods of folding activity.

1) Caledonian Era: There were two periods of uplift-subsidence. The early Cambrian was a period of subsidence, with 1,000 to 1,400 meters of clastic rock sediments. The crust was uplifted at the end of the sedimentation period, so it lacks the middle and upper Cambrian and lower Ordovician systems (the entire Ordovician system is missing in some areas). There was another period of subsidence at the onset of the Silurian. The Longmen Shan geosyncline and the area around it subsided violently, and the sediments are 1,500 to 3,000 meters thick. The Caledonian movement at the end of the Silurian era caused the Tianjingshan area to be uplifted, and the Silurian system was subjected to substantial erosion. The areas around Tianjingshan, Nianziba and other places were almost denuded, forming the Tianjingshan ancient uplift at a scale of over 1,000 meters (Figure 3.)

This was an important movement that had a stretching quality, causing the area to become separated into the Tianjingshan uplift and the Tangwangzhai depression, forming an obvious boundary with the Sichuan block. The Devonian and Carboniferous systems that formed on the basis of this movement are piedmont and geosynclinal sediments bounded by the Sichuan block. The sediments are thickest, over 5,000 meters, in the Tangwangzhai depression.

2) Uplift movement during the first Indosinian episode.

The area underwent a stage of continuous subsidence following the Caledonian movement. Strata 3,000 to 8,000 meters thick composed primarily of shallow-sea carbonatite formed from the Devonian through the lower and middle Triassic systems. The movement during the first Indosinian episode at the end of the middle Triassic caused another uplifting of the crust. The sea regressed and all of Sichuan became continental. The uplifting was most intense in the Tianjingshan ancient uplift. There was intense denudation of the Leikoupo group, leaving only Lei 2 and Lei 3 strata just 300 to 500 meters thick. The area around Xiangshui, Majiaoba and Huangjiashan on the northwestern side of the uplift remained a depression, however, and retains the Lei 5 stratum (Tianjingshan limestone). The Leikoupo group has a total thickness of 800 to 1,100 meters (Figure 4). Like the Caledonian movement before it, this movement involved block

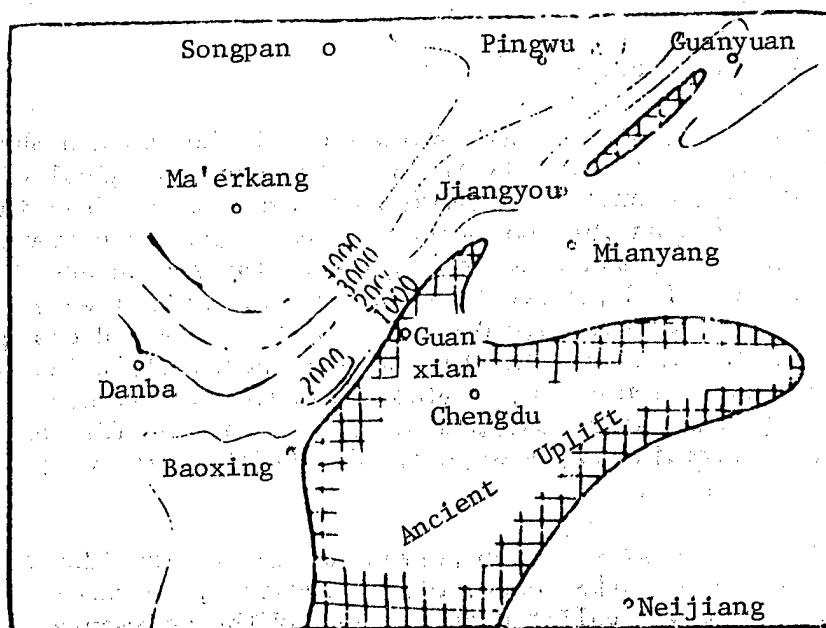


Fig. 3 Thickness of the Silurian System in the Longmen Shan Area

fault movement with a stretching quality, and thereby laid the structural foundation (fractures and fold) for the formation of the Longmen Shan overthrust fracture zone. During the Ma'antang marine facies sedimentation stage in the early part of the late Triassic, the strata obviously were controlled by the Tianjingshan ancient uplift and formed a disconformity contact with the Lei 5 stratum. There are no Ma'antang group sediments on the southeastern side of the uplift, however, and they began gradually to override the Tianjingshan ancient uplift only by the time of Xiaotangzi and Xujiahe sediment groups (Figure 5).

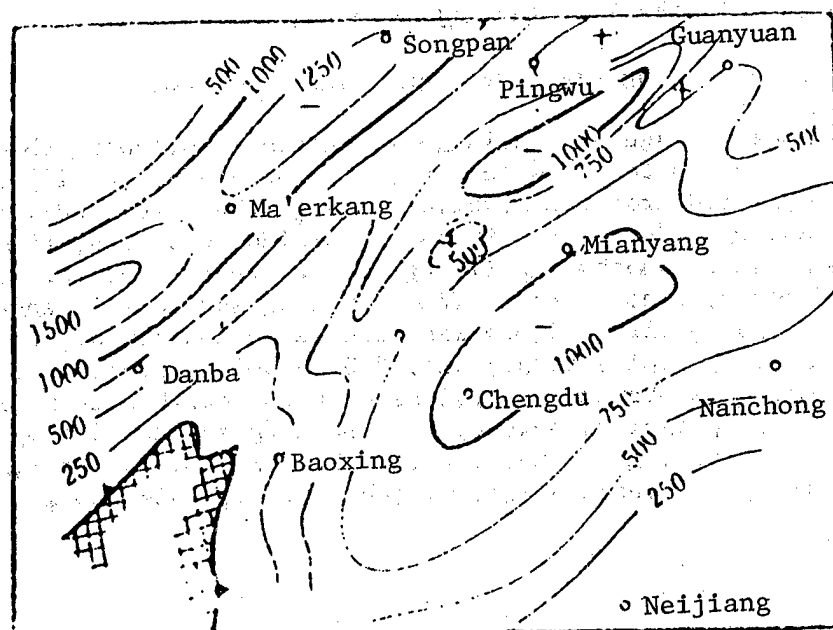


Fig. 4 Thickness of the Triassic System in the Longmen Shan Area

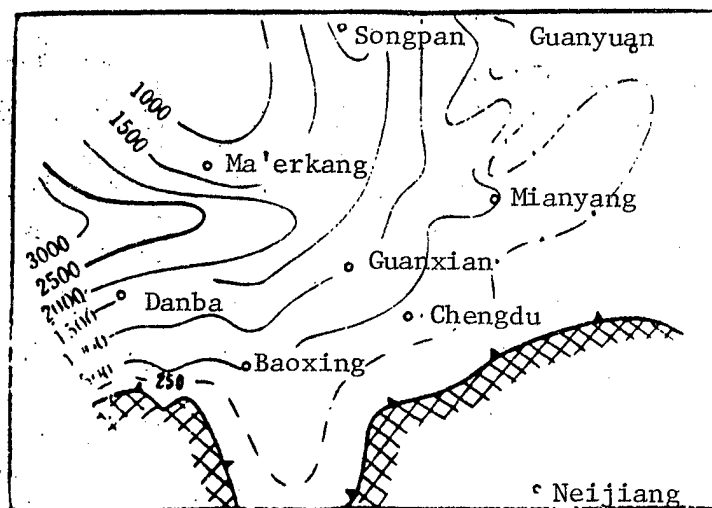


Fig. 5 Thickness of the Marine Facies Segment of the Upper Triassic in the Longmen Shan Area

3) Folding movement during the second Indosinian episode

The Triassic system in the Longmen Shan region are typical geosynclinal sediments 2,000 to 3,000 meters thick. This author considers the so-called Longmen Shan geosyncline to be primarily a Triassic era geosyncline. There was intense folding activity during the second Indosinian episode at the end of the late Triassic. As the Xitailing and Motianling areas were folded and compressed, the geosyncline was folded upward and caused folding in the overthrust fracture zone, creating the embryonic form of the Longmen Shan overthrust fracture zone. The geosyncline became a mountainous area after the folding and the Sichuan Basin developed from marine facies to continental facies.

4) Xishan period:

This was a period of intense folding activity over a wide area that intensified the transformation of the overthrust fracture zone that was based on the original period of Indosinian folding and fracturing. The Longmen Shan geosyncline was deformed and metamorphized by compression, causing the Indosinian faults to become active and forming today's Longmen Shan overthrust fracture zone (Figure 2). Although there is no direct record of the northeastern segment of the overthrust zone during the Xishan movement, there is a record in survey reports on the Songpanfu region in the area of the geosyncline: There is a disconformity in the Miocene Maladun group and the Pliocene Tupu group above the upper series of the Triassic system, and there also is an angular unconformity between the Miocene and Pliocene series. There has been reversal, and there is an angular unconformity with the Quarternary. This shows that the Xishan movement was not only intense, but also that there were multiple periods of movement. For this reason, the Longmen Shan overthrust fracture zone was formed primarily by Xishan movement.

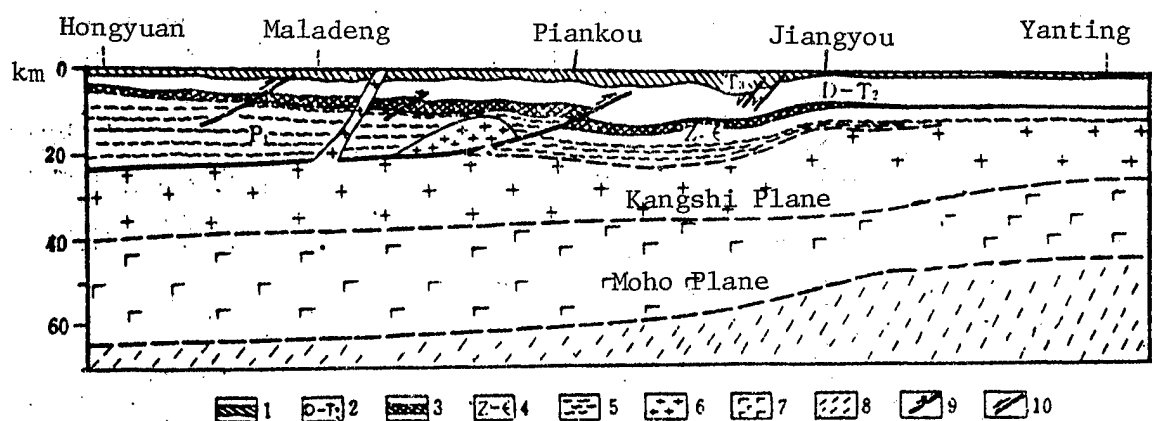


Fig. 6 Structural Profile of the Indosinian Period in the Northern Section of the Longmen Shan Overthrust Zone

Key:

- | | |
|---------------------------------|-------------------|
| 1. Upper Triassic | 6. Salic stratum |
| 2. Devonian-Middle Triassic | 7. Humite stratum |
| 3. Silurian | 8. Upper Mantle |
| 4. Sinian-Cambrian | 9. Reversed fault |
| 5. Protozeroic metamorphic rock | 10. Normal fault |

In summary, I feel that the crustal structure and formational mechanisms of the Longmen Shan overthrust fracture zone have certain characteristics of a land suture line in plate tectonics. It is different, however, in that the subducted wall is a stable block, not oceanic crust. The abducted wall is late Triassic geosynclinal sediments, an active block and an uplift, not a continent. There is a shallow-sea subsidence zone between the Paleozoic and Triassic, not a deep-sea trench. The active wall was the abducted flank, not the subducted flank, so it is different from a trench-arc system.² It is possible that this sort of relationship was a form of collision with a continental plate. Because this overthrust fracture zone developed on the foundation of a shallow-sea subsidence zone, there were very good conditions for the generation of oil and gas. The thick crust and small ground temperature gradient (1.6 C°/100 meters) aided in protecting the oil and gas, so it is a favorable region to explore for oil and gas.

The Longmen Shan overthrust fracture zone underwent a long period of development and is still active at the present time. As Figure 1 shows, it is possible that the zone of earthquake epicenters in the region is concentrated in the overthrust fracture zone.³

II. Geological Structures in the Longmen Shan Overthrust Fracture Zone

Some people feel that the characteristics of the Longmen Shan overthrust fracture zone indicate that the fracture zone is primarily a thrust fault, and that there is no large-scale horizontal thrust. Others feel that it primarily is a large nappe, and that the Tangwangzhai syncline is a nappe outlier. Another opinion

is that it is a zone of plate collision. A small amount of seismic work done in the region between Haitangpu and Houba in Jiangyou and on the southeastern flank of the Tangwangzhai syncline in recent years has deepened our understanding. This seismic data has been combined with well and surface geology data to compile the horizontal profile shown in Figure 7, which illustrates clearly that the Longmen Shan fracture zone is a thrust zone dominated by compressive imbricate overthrust fractures. The fault is steep at the top and gentle at the bottom, gradually becoming more level moving downward. The surface generally has an incline of about 75° . Seismic data indicate that the Permian and Triassic systems generally have an incline of less than 45° . This is an important indicator of a nappe zone. This sort of structure mainly is the result of horizontal thrust over a long distance along the fault plane.

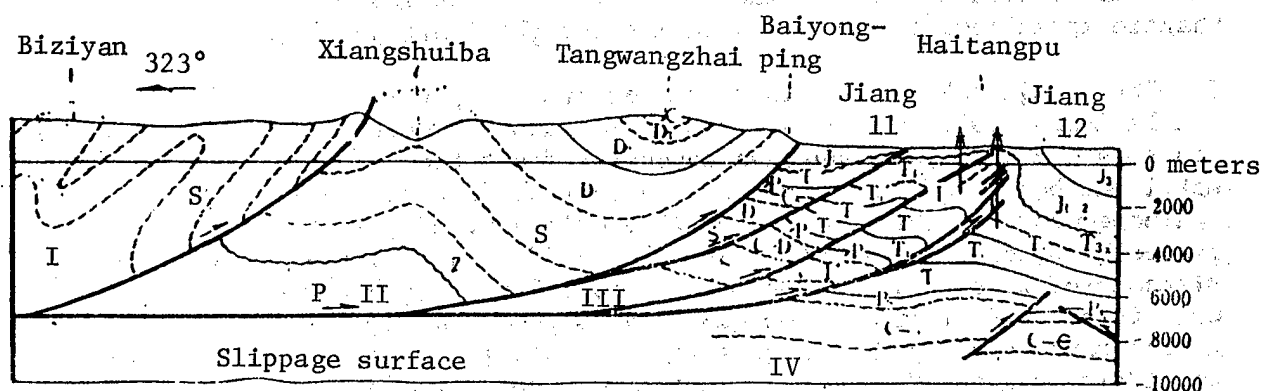


Fig. 7 Horizontal Structural Profile of the Longmen Shan Overthrust Fracture Zone

Key:

- I. Rear Longmen Shan overthrust body
- II. Tianwangzhai synclinore overthrust body
- III. Tianjingshan anticlinorium overthrust body
- IV. Hidden structural bodies

1. The structure of the overthrust fault zone

Figure 7 shows that the overthrust fracture zone is composed of three nappes and one concealed zone. There is a zone of imbricate stepped rifts with a northwest-southeast orientation. The nappes are:

1) The Houlongmenshan overthrust nappe: This nappe is located on the upper wall of the Beichuan-Chaba fracture. The primary fracture is the Beichuan-Chaba overthrust fault that extends vertically for 4 kilometers and horizontally for 11 kilometers. The surface fault is inclined at an angle of 60° to 75° , and the upper wall of the fault is from the metamorphic lower Cambrian to Silurian. Lithologically, there is slightly metamorphized phyllite. Because it is the moving wall, the folding is extremely intense with complete reversal of entire

faults along an axis oriented to the northwest, and there are very few fractures. The folding and metamorphosis indicates that after metamorphosis from the compressive folding activity during the second Indosinian episode, Xishan movement caused the compression to continue and intensified the metamorphosis.

2) The Tangwangzhai synclinorial overthrust nappe: This is located between the Beichuan and Majiaba faults. The primary fault is the Majiaba fracture zone, which generally is a group of mutually intersecting overthrust fractures. It covers a vertical distance of 5 kilometers and a horizontal distance of 7 to 8 kilometers. The upper part of the fault is inclined 45° , while the bottom part is inclined by only 10° or may even be level. The Tangwangzhai synclinore in the Silurian, Devonian and Carboniferous systems in the upper wall has a steep flank to the southeast and a gentle flank to the northwest. There is very little reversal of strata and no metamorphosis. The synclinore is composed of the Shantie anticline, the Chaba anticline and the Tangwangzhai syncline.

3) The Tianjingshan anticlinorium overthrust nappe: This is located between the Majiaba fault and the Jiangyou-Guangyuan concealed fault. The primary fault is the Jiangyou-Guangyuan concealed fault that generally extends upward until the bottom of the Jurassic, where it disappears. Seismic data show that the upper part of the fault plane is inclined by 30° , while the lower part gradually becomes more gentle, at 20° to 15° . The fault extends for a vertical distance of 2 to 3 kilometers and horizontally for about 5 kilometers. The upper wall is an anticlinorium zone that developed out of the Tianjingshan ancient uplift which developed a large number of anticlinal structures and several secondary faults. Most of the surface outcrops are from the Paleozoic to Jurassic systems. The anticlinal structures generally have a steep southeastern flank with associated reversed faults, while the northwest flank is gentle and sometimes has normal faults. The lower wall at the surface generally is a monocline composed of Jurassic red beds with concealed structures in the ventral region.

4) The concealed structure in the lower wall of the Jiangyou-Guangyuan fracture: Seismic data indicate that there are concealed gentle anticlines and nose-shaped structures under the gentle fault such as the Shuanghekou fault, the Qinglinkou fault nose, the Permian system anticline in the deep portions of Haitangpu, the Sunjiashan structure at Guangyuan, and so on. These concealed structures were formed primarily by the thrust of the overthrust fault, so they are included in the overthrust fracture zone.

These four components show that there are gradual changes moving from northwest to southeast. The intensity of folding weakens, the degree of metamorphism lessens gradually or disappears, the strata become newer, and the scale of the fault thrust becomes increasingly smaller, to the extent of becoming a concealed fracture, forming a stepped imbricate thrust zone.

When comparing the four components, the Tianjingshan anticlinorium and concealed zone have the favorable conditions of better oil- and gas-bearing conditions, more structures, new outcrop strata, good conservation conditions, a moderate structural range, and concealed structure development in the ventral region. It is a primary battleground in the search for oil and gas. In the Tangwangzhai synclinore zone, however, most of the anticlines lie very close to

the large Beichuan fault. The strata are slightly metamorphized, there is intense structural folding, the outcrop strata are fairly old, and the structures in the ventral region are complex. The prospects for oil and gas in this area are not as good as the first two.

2. Classification of structural traps in the overthrust fracture zone

Seismic, surface geology and drilling data indicate three types of traps in the overthrust zone:

- 1) Traction anticlinal structures in the upper wall of the fault. This type of structure is generally seen at the surface and are found mainly in the Tianjingshan anticlinorium zone. Examples include the structures at Tianjingshan, Kuangshanliang, Nianziba, Feixianguan, Gangou, Hewanchang, Daliangzi, Daoliuhe, Haitangpu, Zhongba and others. The results of exploratory drilling generally show oil and gas, but there is a great deal of variation in the structures in the ventral region. Oil and gas reservoirs were found only in the two fairly low structures at Zhongba and Hewanchang. For this reason, exploratory drilling can be done only after investigating the structures in the central region of this structure.
- 2) Concealed structures in the lower wall of the fault. This type of structure has only been found in areas where seismic work has been done, and occur mainly in the zone concealed by the overthrust fault. Examples of this type of structure include the concealed Permian system structure at Haitangpu, the nose-shaped structures that may exist in the Qinglinkou and Shuanghekou zones, the concealed anticline at Zhuyuanba, and others. These structures are buried deep and are concealed, and they have excellent preservation conditions. They are an important target of exploration.
- 3) Imbricate anticlines within the fracture zone. Seismic surveys have revealed only the Yongping and Zhonghuayan anticlines on the eastern side of Haitangpu. They developed along the secondary faults in the third thrust zone. The Yongping structure, for example, has Jurassic outcrops and shallow target strata, so exploratory drilling is easy.

The above conditions show that many types of anticlinal structures developed in the Longmen Shan overthrust fracture zone. Seismic exploration is expected to reveal even more structures and provide even more well sites for exploratory drilling.

III. Large Numbers of Oil and Gas Occurrences and Abundant Oil and Gas Sources

The Longmen Shan overthrust fracture zone not only contains several structures suited to rich oil and gas accumulations, but also has excellent conditions for oil and gas generation.

1. Abundant oil and gas occurrences. The rich oil and gas seepages in the region are nationally famous. According to statistics, there are a total of 262 oil and gas seepage sites, including 73 oil seepages, 30 gas seepages and 159 bitumen veins. Apparently, all strata systems between the Sinian system and the upper Shaximiao group in the Jurassic system have them. The largest oil seepage is the Houba oil sandstone in the lower part of the upper Shaximiao group. The

distribution of the best oil-bearing segment ranges from Houba in Jiangyou County in the southwest to Leijiahe in the northeast. Exploratory drilling has proven, however, that this is a destroyed oil pool. Analysis of the condensate shows high sulfur content, low wax content, and high saturated hydrocarbons. These characteristics indicate that the oil migrated from the deep marine facies strata to accumulate in the red beds of the Shaximiao group.

The second enormous oil and gas seepage is the 138 bitumen veins that have been found in the three structures at Tianjingshan, Nianziba and Kuangshanliang. The largest bitumen veins are the Erchangliang No 1, 2 and 3 bitumen veins at Tianba. They are 8 meters wide and may extend for more than 100 meters and be as much as 35 meters high. Well depths have reached 164 meters. It is estimated that there is a total of 478,000 cubic meters of bitumen. There are also two other zones of fair concentration: There are 18 bitumen veins at Tianba in the Nianziba structure with 210,000 m³ of bitumen. There are 25 bitumen veins at Macun at the northern end of the Kuangshanliang structure with a total of 77,000 m³ of bitumen (unfortunately, none has been extracted and utilized). Analysis of the spore-pollen groups in the bitumen prove that all of it came from the Cambrian system.

It can be seen that there is abundant oil and gas in the Longmen Shan overthrust fracture zone and that substantial oil and gas pools formed, but later destruction played a major role.

2. There are excellent oil generation strata and rich oil and gas sources. Research indicates that there are three fairly good oil source strata: the lower Cambrian system, the Permian system, and the Xujiahe group in the upper Triassic system. They are broadly distributed and have fairly good geochemical indicators for oil and gas generation (see Table 1).

Geochemical indicators of oil generation show that the lower Cambrian system was the best oil generator with total hydrocarbon concentration of 816 ppm. The Xujiahe group and the Permian system had lower figures. Using the bitumen method to calculate the amount of oil based on the data in the table above, the three strata would total 10.0394 billion tons, equivalent to 6 trillion cubic meters of natural gas.

The three strata mentioned above were not the only sedimentary rock that produced oil in the region. The Devonian, Carboniferous, middle and lower Triassic and Silurian systems all had a certain oil generation capacity. According to preliminary research, the middle and lower Triassic and Devonian systems produced a total of 6.9905 billion tons of oil. Total oil generation in this manner equalled 17.0219 billion tons, equivalent to 10.2126 trillion cubic meters of natural gas. It deserves mentioning that the region has a low degree of mechanical metamorphism. The vitrain reflection rate R_o value is 0.99 in the Xujiahe group and 0.756 in the Permian system, both of which are within the oil formation stage. There is, therefore, hope for finding both oil and gas. Moreover, the oil source region has an identical location with the Tianjinshan anticlinorium and the concealed zone, so there is a fairly good match between the structures and the oil and gas generation region. This increases the possibility that they contain oil and gas and raises their evaluation for bearing oil and gas.

Table 1. Geochemical Indicators of Oil Generation in the Longmen Shan Area

Stratum	Profile	Thickness of source stratum (meters)	Organic carbon (%)	Hydrocarbon "A" (%)	Total hydro- carbon con- centration (ppm)	Composition of hydrocarbon groups (percent)		
						Satur- ated hydro- carbons	Aroma- tic hy- drocar- bons	Bitu- men
T3x	Chuan 19 Well	470-620	2.1	0.15-0.77	183-427	13-24	5-24	66-75
P2	Changjiang Gorge	80-100	0.4-1.2	0.031	170	35	20	18
P1	Changjiang Gorge	150-200	0.328	0.031-0.06	216	23-29	13-23	18-19
1	Baijia Gorge	387	0.36	0.136	816	34-73	9-32	11-31
								1.7-17

IV. Relatively Good Oil and Gas Reservoir Strata

Research on surface geology and exploratory drilling have proven that there are quite a few oil and gas accumulation strata distributed over a broad area in the Longmen Shan overthrust fracture zone. The lithologically stable reservoir strata occur mainly in three strata segments:

1. The Xujiahe No 2 segment, or Xu 2 sandstone

This is one of the primary strata in the Zhongba gas pool. The sandstone is 170 to 270 meters thick, and is composed of fine and medium grained lithic feldspathic quartz sandstone interbedded with thin strata of sandy mudstone and several orthorhythmic components from coarse to fine grains moving horizontally. Results of analyzing 1,516 rock samples from 24 wells in the nine structures shows an average porosity of 5.4 percent, most of them being secondary pores, and permeability generally is less than 1 millidarcy. Exploratory drilling also has proven that the stratum is primarily of the fissure pore type. Alone, the secondary intergranular pores could only serve as spaces for the accumulation of oil and gas, but the permeability is poor. Permeability was possible only with the development of fissures to form fairly good generation strata. The special characteristics of this reservoir stratum is that there generally is no output if fissures are not found during drilling. Once output is achieved, it generally can be stabilized, so it may be regarded as a regional reservoir stratum.

2. The Leikoupo group's third segment, or the Lei No 3 reservoir stratum

This is a set of orchid-green algal dolomite 100 to 250 meters thick with an algae content generally ranging from 25 to 60 percent. It is fine and medium crystalline and developed a large amount of intergranular and intragranular pores. It is excellent porous dolomite. Research done by the Southwest Petroleum Geology Bureau of the Ministry of Geology and Mineral Resources indicates that most of the pores show up under the microscope as dissolution pores, with only 4.4 percent being original pores. Most of them are vulgar pore spaces formed during and after the later period of rock formation. The occurrence of the vulgar pore spaces was controlled by lithic qualities. Algae-bearing dolomite was the primary factor in the development of the vulgar pore spaces. Statistics on the pores in thin section show that 79.4 percent are algae-bearing dolomite. Analysis of data from 12 wells and 5 surface profiles shows that maximum porosity is 29 percent, with an average of 3.34 percent. Average permeability is 2.44 millidarcys. The segment where the pores developed is 50 to 168 meters thick, and averages 90 meters. The scope of its distribution is restricted only to the Longmen Shan overthrust zone, and is a very good carbonatite reservoir stratum. It is characterized by a large effective thickness, high porosity, and fairly broad distribution. Exploration in the Zhongba gas pool has proven that the amount of reserves per unit area in the Lei 3 reservoir stratum is the largest in Sichuan. There is no doubt that this is one of the primary strata segments for future exploration in the Longmen Shan overthrust fracture zone.

3. The lower series of the Permian system, with two reservoir strata

1) The lower segment of the Maokao group (P₁₂³): This is a regional reservoir stratum about 100 meters thick composed of brownish gray biotritus and biolimestone. It has an organic content of 30 to 60 percent and is of pure quality. Natural gas has come from every well drilled to this stratum in northwest Sichuan. An example is the industrial gas flow at Hewanchang, and there also was a gas spout at Jiulongshan.

2) The second segment of the Qixia group (P₁₂²): In this region, this is grayish-white red algal sparry limestone or grayish-white sugar granular dolomite generally more than 40 meters thick. There is alternating limestone and dolomite, and the dolomite is fairly porous. Analysis of the Kuangshanliang profile shows a maximum porosity of 4.22 percent and a minimum of 1.28 percent, with an average of 2.45 percent. Permeability ranged from 0.38 to 0.95 millidarcys. It is a potential reservoir stratum.

Apart from the three fairly good reservoir strata mentioned above, the Devonian and Carboniferous carbonatite and the lower Cambrian sandstone could have become reservoir strata.

To summarize the situation in the four areas described above, the Longmen Shan overthrust fracture zone not only has structures, oil generation and excellent oil and gas reservoiring strata, but also formed oil and gas pools that have excellent prospects for oil and gas exploration. We must, of course, note the unfavorable conditions of extreme structural complexity and the destruction of oil and gas pools over geological history. Areas with the conditions for preservation definitely may have rich accumulations of oil and gas. Like the Sichuan Basin, Longmen Shan has multiple reservoir strata, multiple oil generation strata and multiple source strata. This is different from the Los Angeles Mountains overthrust fracture zone in the United States in that there are relatively broad spheres for exploration.

On this basis, the author feels that there should be active exploration work in the Longmen Shan overthrust fracture zone. The key to our urgent need for seismic exploration is investigation of the geological structures and structural traps and integration with geological research work to make good structural preparations. There are major prospects for finding new oil and gas pools.

FOOTNOTES

1. Zhao Younian [6392 0645 1628], "Certain Questions Concerning the Longmen Mountains and the Major Nearby Structures," *TIANRANQI GONGYE*, No 4, 1983.
2. Hunt (Yabale), *Geology of Continental Margins*, Petroleum Industry Press, 1983 [translated version].
3. Southwest Intensity Team, State Geology Bureau, *XINAN DIQU DIZHEN DIZHI JI LIEDU QUHUA TANTAO* (A Discussion of Seismic Geology and Intensity Zones in the Southwest Region), Seismic Press, 1977.

29 April 1985

OIL AND GAS

BRIEFS

MORE LIAOHE RESERVES REPORTED--This year [1984] prospecting work at the Liaohe fields found double the petroleum geological reserves than the year before, making the fields a national leader in this area. Breakthroughs were made in drilling technology, giving new life to old wells. New technology and directional drilling speeded up the recovery of crude. This year, the Liaohe Oil Fields produced some 7.6 million tons of crude oil, an increase of 24.5 percent over 1983. The entire year's production plan was met 15 days ahead of schedule and on 29 December crude output hit 10,005 tons, the first time the 10,000-ton mark has been exceeded. [Summary] [Shenyang LIAONING RIBAO in Chinese 31 Dec 84 p 1]

DAQING REPORTS RECORD PRODUCTION--Harbin, 13 Apr (XINHUA)--Daqing, China's biggest oil field, produced a record 13,615,400 tons of crude oil in the first quarter of this year, more than the same period of any previous year. This is 384,200 tons more than in the first quarter of last year and exceeded the quota by 25,400 tons, the oil field administration reported today. Daqing, in Heilongjiang Province, produces over half of China's oil. [Text] [Beijing XINHUA in English 1442 GMT 13 Apr 85 OW]

CSO: 4010/128

NUCLEAR POWER

BRIEFS

JIANGSU 1,800MW PLANT PLANNED--The Sunan Nuclear Power Plant, China's second largest nuclear power plant using foreign equipment, will be built in Jiangyin, Southern Jiangsu Province. The nuclear power plant is one of the key construction projects of the state's Seventh 5-Year Plan. When installation of its two nuclear power generators is completed, it will have a generating capacity of 1.8 million kilowatts. [Summary] [Shanghai City Service in Mandarin 0100 GMT 2 Mar 85 OW]

CSO: 4013/102

SUPPLEMENTAL SOURCES

BRIEFS

GANSU 10KW SOLAR POWER STATION--Lanzhou, 16 March (XINHUA)--Work will begin later this month on China's first solar energy plant. The scheme, in Yuzhong County, Gansu Province, is being financially backed by two Japanese firms. The 10-kilowatt plant is scheduled to be completed in September. Construction funds will be provided by Japan's Kyoto Ceramics Company and the Mitsubishi Corporation. The plant will be able to supply electricity for up to 7 overcast days in a row by means of its energy-storage batteries. [Text] [Beijing XINHUA in English 1601 GMT 16 Mar 85 OW]

CSO: 4010/112

CONSERVATION

BRIEFS

1984 INDUSTRY CONSERVATION--Beijing, 26 February 1985 (XINHUA)--According to estimates by concerned departments, China in 1984 conserved approximately 30 million tons of standard coal, the best performance for the nation in the last 4 years. Statistics show that nationwide, industry at the county level and above saved some 20 million tons of standard coal. [Excerpts] [Hangzhou ZHEJIANG RIBAO in Chinese 27 Feb 85 p 1]

CSO: 4013/108

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